FLUKE

CHANGE/ERRATA INFORMATION

ISSUE NO: 1   10/93

This change/errata contains information necessary to ensure the accuracy of the following manual. Enter the corrections in the manual if either one of the following conditions exist:

1. The revision letter stamped on the indicated PCA is equal to or higher than that given with each change.
2. No revision letter is indicated at the beginning of the change/errata.

MANUAL

Title: 5700A Service
Part Number: 791996
Print Date: February 1990
Rev.- Date: 5, 2/93

C/E PAGE EFFECTIVITY

Page No.	Print Date
1	10/93
2	10/93
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ERRATA #1

On page 2-39, Table 2-10, change the NOMINAL OUTPUT,

FROM: +17.475V TO: +17.000V
-17.865V -17.000V

ERRATA #2

On pages 3-33, Table 3-14,

DELETE: Thermal Transfer Standard Fluke 540B

On page 3-35, Figure 3-9,

CHANGE: 540B TRANSFER STANDARD
TO: 792 AC/DC TRANSFER STANDARD

ERRATA #3

On page 3-59, Table 3-32, under MINIMUM USE SPECIFICATIONS, change ITEM 2,

FROM: 1Ω nominal, true value certified to
Standards within 6 ppm Series 1Ω and
10 kΩ 10 kΩ nominal, true value certified to within 3.5 ppm

TO: 1Ω nominal, true value certified to within 10 ppm

10 kΩ nominal, true value certified to within 4 ppm

ERRATA #4

On page 6-55, Table 6-16,

ADD: C116,117|CAP,AL,10UF,+/-20%,63V|816843|62643|KME63T10RMX11RP|2

CHANGE #1 - 46758

On page 6-5, Table 6-1,

CHANGE: MP6|GROMMET,NYLON,NAT,.056X.150X.100X.155|285254|03296|G51P-A|1
TO: MP6|GROMMET,EXTRUDED,POLYETHYENE,.085
|854351|95987|GRPE-085-9|1

On page 6-8, Table 6-1a,

CHANGE: H2-10|SCREW,MACH,PH,P,STL,6-32,.500|152173| |COMMERCIAL|9
TO: H2-10|SCREW,MACH,PH,P,SS,6-32,.500 |320051| |COMMERCIAL|9

CHANGE: H45-56|SCREW,CAP,SCKT,SS,8-32,.375|837575| |COMMERCIAL|12
TO: H45-56|SCREW,CAP,SCKT,SS,8-32,.375|295105| |COMMERCIAL|12

ADD: MP9,10|WASHER,FLAT,STL,.160,.281,.010 |111005|89536|111005|2

CHANGE: MP31-44,50-53,131,132|WASHER,LOW THERMAL #8
|859939|89536|859939|20
TO: MP31-44,131,132 |WASHER,LOW THERMAL #8
|859939|89536|859939|16

DELETE: MP106,107|WASHER,FLAT,STL,.191,.289,.010|111047|
|COMMERCIAL|2

On page 6-11, Table 6-1b,

CHANGE: MP2|GROMMET,NYLON,NAT,.056X.150X.100X.155|285254|03296|G51P-A|1
TO: MP5|GROMMET,NYLON,NAT,.056X.150X.100X.155|285254|03296|G51P-A|1

ADD: MP2|GROMMET,EXTRUDED,POLYETHYENE,.085
|854351|95987|GRPE-085-9|1

MP106,107|WASHER,FLAT,STL,.191,.289,.010|111047|
|COMMERCIAL|2
MP125-130|WASHER,FLAT,STL,.160,.281,.010 |111005|89536|111005|2

DELETE: MP8,9|WASHER,FLAT,STL,.160,.281,.010|111005| |COMMERCIAL|2

On page 6-12, Figure 6-1b, change MP2 to MP5.

CHANGE #2 - 46556

On page 7-11, Figure 7-3, add K1 through K13 pin configurations as shown in Figure C, and add the following note next to the boost cable located in Zone D3: TO PAGE 4 OF 5700A-1009.

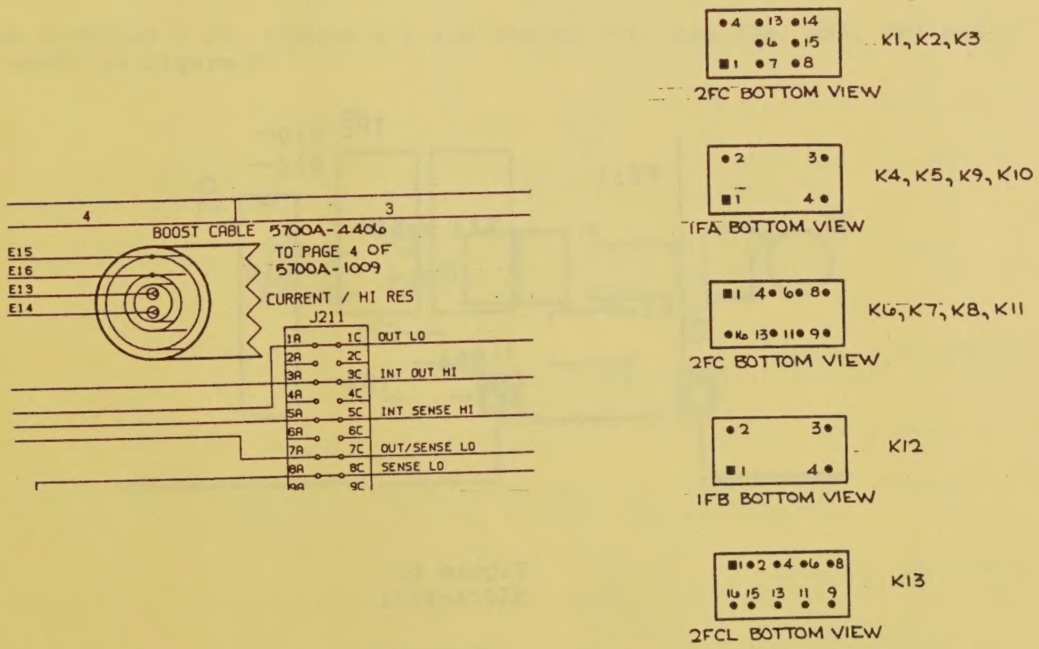

Figure C.
5700A-1001

CHANGE #3 - 47672
Rev. -G, A4 Digital Motherboard PCA (5700A-7605)

On page 6-20, Table 6-5,

DELETE: J41|CONN,DIN41612,TYPE C,64 SCKT
|853853|88245|96S-6033-0531-2-C|1

CHANGE: J51,52 |HEADER,1 ROW,.100CTR,3 PIN|845334|00779|640456-3|2
TO: J41,51,52|HEADER,1 ROW,.100CTR,3 PIN|845334|00779|640456-3|3

CHANGE #4 - 47566
Rev. -P, A7 Current/High-Res Oscillator PCA (5700A-7621)

On page 6-30, Table 6-8,

CHANGE: C1 |CAP,CER,0.22UF,+80-20%,50V,Z5U
|649939|04222|SR595E2242AA|1
TO: C1,71|CAP,CER,0.22UF,+80-20%,50V,Z5U
|649939|04222|SR595E2242AA|2

CHANGE: C69|CAP,CER,47PF,+/-2%,100V,COG|812123|04222|SR291A470GAA|1
TO: C69|CAP,CER,27PF,+/-2%,100V,COG|816652|04222|SR591A270GAA|1

On pages 6-33 and 7-27, Figure 6-8 and Figure 7-7, add C71 as shown in Figure D.

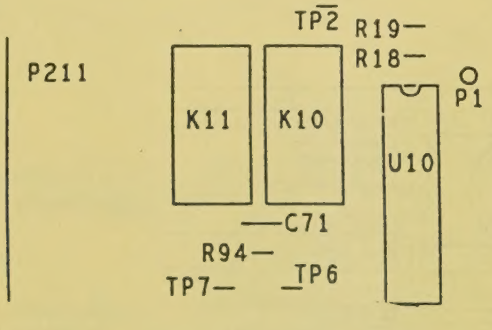

Figure D.
5700A-1621

On page 7-28, Figure 7-7, add J1 and C71 as shown in Figure E, and change the value of C69,

FROM: 47PF TO: 27PF

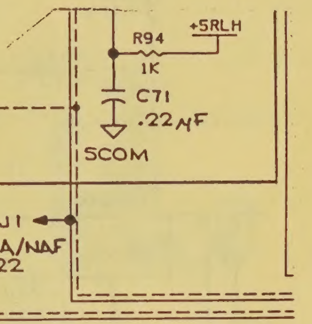

Figure E.
5700A-1021

CHANGE #5 - 47634,47670
Rev. -N, A8 Switch Matrix PCA (5700A-7620)

On page 6-34, Table 6-9,

ADD: R36,37|RES,MF,4.99K,+/-1%,0.125W,100PPM|721548|59124|MF55D4991F|2
VR3,4 |ZENER,UNCOMP,5.1V,5%,20.0MA,0.5W|853700|04713|1N5231B |2

On pages 6-36 and 7-32, Figure 6-9 and Figure 7-8, add R36, R37, VR3 and VR4 as shown in Figure F.

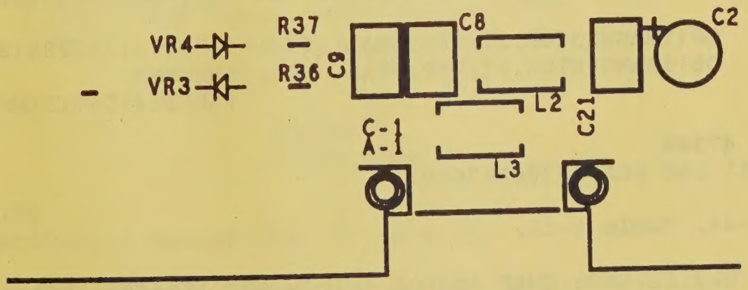

Figure F.
5700A-1622

On page 7-34, Figure 7-8, add R36, R37, VR3 and VR4 as shown in Figure G.

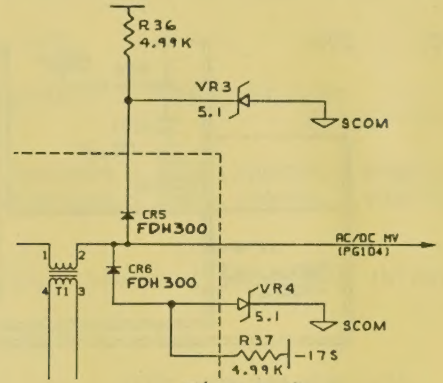

Figure G.
5700A-1020

CHANGE #6 - 48276
Rev. -P, A8 Switch Matric PCA (5700A-7620)

On page 6-34, Table 6-9,

ADD: MP18-21|SPACER.156 ROUND SOLUBLE,.062,.060
|296319|32559|T0-8-06|4

CHANGE #7 - 46584
Rev. -K, A11 DAC PCA (5700A-7640)

On pages 6-42 and 6-43, Table 6-12,

CHANGE: H1|SCREW,PH,P,STL,LOCK,6-32,.500|152173|73734|19046 |1
TO: H1|SCREW,PH,P,LOCK,SS,6-32,.500 |320051|89536|320051|1

CHANGE: Q8|TRANSISTOR,SI,PNP,SMALL SIGNAL|288761|56289|288761|1
TO: Q8|TRANSISTOR,SI,PNP,SMALL SIG,SELECTED
|380394|04713|MPS404A|1

CHANGE #8 - 47596
Rev. -M, A11 DAC PCA (5700A-7640)

On page 6-44, Table 6-12,

CHANGE: U23|IC,DMOS,QUAD ANALOG SWITCH,SOIC|806687|17856|SG4234T1|1
TO: U23|IC,DMOS,QUAD ANALOG SWITCH,SOIC|928291|89536|928291 |1

CHANGE #9 - 47645
Rev. -L, A12 Oscillator Control PCA (5700A-7650)

On pages 6-52 and 6-53, Table 6-15,

ADD: R59,60|RES,MF,4.99K,+/-1%,0.125W,100PPM|721548|59124|MF55D4991F|2
VR7,8|ZENER,UNCOMP,5.1V,5%,20.0MA,0.5W |853700|04713|1N5231B |2

On pages 6-54 and 7-57, Figure 6-15 and Figure 7-14, add R59, R60, VR7 and VR8 as shown in Figure H.

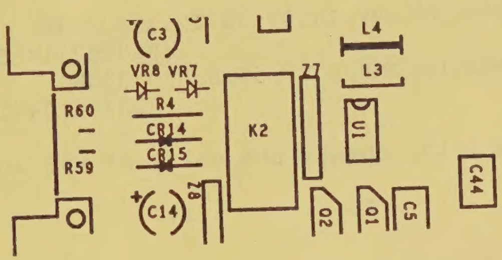

Figure H.
5700A-1650

On page 7-58, Figure 7-14, Figure 7-14, add R59, R60, VR7 and VR8 as shown in Figure I.

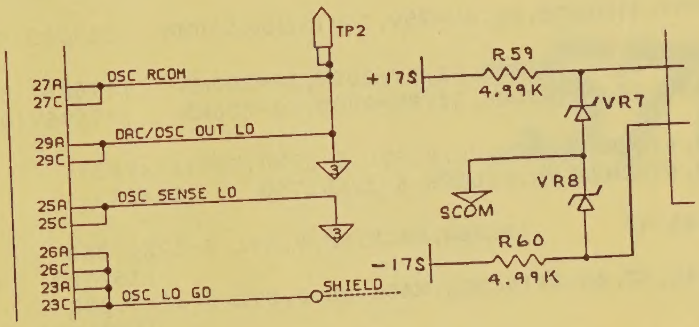

Figure I.
5700A-1050

CHANGE #10 - 46759
Rev. -H, A13 Oscillator Output PCA (5700A-7651)

On page 6-55, Table 6-16,

CHANGE:	H9-12	SCREW,MACH,PH,P,STL,6-32X0.250	152140	COMMERCIAL	4
TO:	H9-12,14,15	SCREW,MACH,PH,P,STL,6-32X0.250	152140	COMMERCIAL	6

CHANGE #11 - 47850
Rev. -J, A13 Oscillator Output PCA (5700A-7651)

On page 6-57, Table 6-16,

```
CHANGE:  VR3,4|ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W
                                            |810267|14552|DZ810317D |2
TO:      VR3,4|ZENER,UNCOMP,9.1V,5%,5MA,0.350W
                                            |853788|04713|1N5239BRR1|2
```

On page 7-63, Figure 7-15, change the value of VR3 and VR4,

FROM: 10.0V TO: 9.1V

CHANGE #12 - 46703
Rev. -U, A16 Power Amplifier PCA (5700A-7670)

On pages 6-68 through 6-70, Table 6-20, make the following changes:

```
FROM:  CR1,2,7,10,12-14....etc|DIODE,SI,BV=75.0V,RADIAL INSERTED
                                         |659516|03508|1N4448|25
TO:    CR1-5,7,10,12-14....etc|DIODE,SI,BV=75,IO=150MA,500MW
                                         |659516|15238|1N4448|27

DELETE: CR3,4|DIODE,SI,BV=75V,I0=150MA,500MW  |203323|09214|1N4448|2

FROM:  CR35-39   |DIODE,SI,BV=200V,I0=200MA   |876867|07263|FDH400|5
TO:    CR35-39,69|DIODE,SI,BV=200V,I0=200MA   |876867|07263|FDH400|6

FROM:  H3,4|SCREW,MACH,PH,P,STL,6-32X0.750|114223|      |COMMERCIAL|2
TO:    H3,4|SCREW,PH,P,LOCK,6-32X0.750    |114223|      |COMMERCIAL|2

FROM:  MP45-47      |SCREW,MACH,PH,P,STL,6-32X0.250
                                        |152140|  |COMMERCIAL|3
TO:    MP41,42,45-47|SCREW,MACH,PH,P,STL,6-32X0.250
                                        |152140|  |COMMERCIAL|5

CHANGE:  R88,91,97,98|RES,MF,10,+/-1%,0.125W,100PPM
                                    |820399|59124|MF50DVT10R0F|4
TO:      R88,97,98   |RES,MF,10,+/-1%,0.125W,100PPM
                                    |820399|59124|MF50DVT10R0F|3
```

CONTROLLED
DOCUMENT

5700A

CALIBRATOR

Service Manual

PN 791996
FEBRUARY 1990 Rev 5, 2/93
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FLUKE ®

WARRANTY

Fluke Corporation (Fluke) warrants this instrument to be free from defects in material and workmanship under normal use and service for a period of 1 year from date of shipment. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke instruments. It is not warranted to be error free. This warranty extends only to the original purchaser and shall not apply to fuses, computer media, batteries or any instrument which, in Fluke's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or handling.

Fluke's obligation under this warranty is limited to repair or replacement of an instrument which is returned to an authorized service center within the warranty period and is determined, upon examination by Fluke, to be defective, If Fluke determines that the defect or malfunction has been caused by misuse, alteration, abuse, or abnormal conditions of operation or handling, Fluke will repair the instrument and bill the purchaser for the reasonable cost of repair. If the instrument is not covered by this warranty, Fluke will, if requested by purchaser, submit an estimate of the repair costs before work is started.

To obtain repair service under this warranty purchaser must forward the instrument, (transportation prepaid) and a description of the malfunction to the nearest Fluke Service Center. The instrument shall be repaired at the Service Center or at the factory, at Fluke's option, and returned to purchaser, transportation prepaid. The instrument should be shipped in the original packing carton or a rigid container padded with at least four inches of shock absorbing material. FLUKE ASSUMES NO RISK FOR IN-TRANSIT DAMAGE.

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

CLAIMS

Immediately upon arrival, purchaser shall check the packing container against the enclosed packing list and shall, within thirty (30) days of arrival, give Fluke notice of shortages or any nonconformity with the terms of the order. If purchaser fails to give notice, the delivery shall be deemed to conform with the terms of the order.

The purchaser assumes all risk of loss or damage to instruments upon delivery by Fluke to the carrier. If an instrument is damaged in transit, PURCHASER MUST FILE ALL CLAIMS FOR DAMAGE WITH THE CARRIER to obtain compensation. Upon request by purchaser, Fluke will submit an estimate of the cost to repair shipment damage.

Fluke will be happy to answer all questions to enhance the use of this instrument. Please address your requests or correspondence to: Fluke Corporation, P.O. Box 9090, Everett, WA 98206-9090, Attn: Sales Department. For European Customers: Fluke Europe B.V., P.O. Box 1186, 5602 B.D., Eindhoven, The Netherlands.

Declaration of the Manufacturer or Importer

We hereby cerfify that the Fluke Model 5700A is in compliance with Postal Regulation Vfg.1046 and is RFI suppressed. The marketing and sale of the equipment was reported to the German Postal Service. The right to retest this equipment to verify compliance with the regulation was given to the German Postal Service.

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß Fluke Model 5700A in Übereinstimmung mit den Bestimmungen der Amtsblattverfügung vfg. 1046 funk-entstört ist. Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

John Fluke Mfg. CO., Inc.

INTERFERENCE INFORMATION

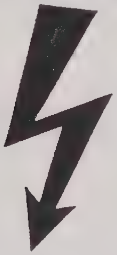
This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the equipment with respect to the receiver
- Move the equipment away from the receiver
- Plug the equipment into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00345-4.

OPERATOR SAFETY SUMMARY

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

LETHAL VOLTAGE

MAY BE PRESENT ON THE TERMINALS. OBSERVE ALL SAFETY PRECAUTIONS!

TO AVOID ELECTRICAL SHOCK HAZARD, THE OPERATOR SHOULD NOT ELECTRICALLY CONTACT THE OUTPUT HI OR SENSE HI BINDING POSTS. DURING OPERATION, LETHAL VOLTAGES OF UP TO 1100V AC OR DC MAY BE PRESENT ON THESE TERMINALS.

WHENEVER THE NATURE OF THE OPERATION PERMITS, KEEP ONE HAND AWAY FROM EQUIPMENT TO REDUCE THE HAZARD OF CURRENT FLOWING THROUGH VITAL ORGANS OF THE BODY.

TERMS IN THIS MANUAL

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus. This Operator Manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

SYMBOLS MARKED ON EQUIPMENT

⚡ DANGER — High voltage.

⏚ Ground (earth) terminal.

⚠ Attention — refer to the manual. This symbol is to indicate that information about usage of a feature is contained in the manual.

POWER SOURCE

The 5700A is intended to operate from a power source that will not apply more than 264V ac rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified on the line voltage selection switch label, and which is identical in type, voltage rating, and current rating.

GROUNDING THE 5700A

The 5700A is a Safety Class I (grounded enclosure) instrument as defined in IEC 348. The enclosure is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired earth grounded receptacle before connecting anything to any of the 5700A terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER POWER CORD

Use only the power cord and connector appropriate for proper operation of a 5700A in your country.

Use only a power cord that is in good condition.

For detailed information on power cords refer to Figure 2-3 in Section 2.

Refer cord and connector changes to qualified service personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate the 5700A in an atmosphere of explosive gas.

DO NOT REMOVE COVER

To avoid personal injury, do not remove the 5700A cover. Do not operate the 5700A without the cover properly installed. There are no user-serviceable parts inside the 5700A, so there is no need for the operator to ever remove the cover.

DO NOT ATTEMPT TO OPERATE IF PROTECTION MAY BE IMPAIRED

If the 5700A appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate it. When in doubt, have the instrument serviced.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Also refer to the preceding Operator Safety Summary

DO NOT SERVICE ALONE

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

USE CARE WHEN SERVICING WITH POWER ON

Dangerous voltages exist at many points inside this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Whenever the nature of the operation permits, keep one hand away from equipment to reduce the hazard of current flowing through vital organs of the body.

Do not wear a grounded wrist strap while working on this product. A grounded wrist strap increases the risk of current flowing through the body.

Disconnect power before removing protective panels, soldering, or replacing components.

High voltage may still be present even after disconnecting power.

FIRST AID FOR ELECTRIC SHOCK

FREE THE VICTIM FROM THE LIVE CONDUCTOR.

Shut off high voltage at once and ground the circuit. If high voltage cannot be turned off quickly, ground the circuit.

If the circuit cannot be broken or grounded, use a board, dry clothing, or other nonconductor to free the victim.

GET HELP!

Yell for help. Call an emergency number. Request medical assistance.

NEVER ACCEPT ORDINARY AND GENERAL TESTS FOR DEATH.

Symptoms of electric shock may include unconsciousness, failure to breathe, absence of pulse, pallor, and stiffness, as well as severe burns.

TREAT THE VICTIM.

If the victim is not breathing, begin CPR or mouth-to-mouth resusciation if you are certified.

Keep the victim warm and lying down.

Do not leave the victim unattended.

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Section 1

Introduction and Specifications

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INTRODUCTION 1-1.

The Fluke Model 5700A Calibrator is a precise instrument that calibrates a wide variety of electrical measuring instruments. The 5700A maintains high accuracy over a wide ambient temperature range, allowing it to test instruments wherever they are, rather than only in a temperature-controlled standards laboratory. With a 5700A, you can calibrate precision multimeters that measure ac or dc voltage, ac or dc current, and resistance. Option 5700A-03 Wideband AC Voltage extends this workload to include many rf meters.

Specifications for the 5700A are provided at the end of this section. The 5700A is a fully-programmable precision source of the following:

- DC voltage to 1100V
- AC voltage to 1100V, with output available from 10 Hz to 1.2 MHz
- AC and DC current to 2.2A, with output available from 10 Hz to 10 kHz.
- Resistance in values of $1\text{x}10^n$ and $1.9\text{x}10^n$ from short to 100 MΩ
- Optional wideband ac voltage from 300 µV to 3.5V (-57 dBm to +24 dBm) 10 Hz to 30 MHz.

The 5700A contains many features that make it an easy-to-use and powerful tool in and out of the standards lab. For a thorough list of these features, refer to the 5700A Operator Manual. The Operator Manual is the primary source of information on all topics relating to operating the instrument in local and remote modes, and also contains a list of Fluke support services that may concern service personnel.

SERVICE INFORMATION 1-2.

Fluke warrants the 5700A to the original purchaser for one year from the time of delivery. The Warranty is located on the back of the title page. If a failure occurs during the warranty period, contact a Fluke Technical Service Center for instructions.

If a failure occurs after the warranty period has expired, Fluke will repair the 5700A for a charge. Depending on your needs, location, and capabilities, you may decide to service you 5700A independently or use Fluke for all or part of repair and full verification tasks. This service manual contains theory, access procedures, troubleshooting information, schematic diagrams, and parts lists that can be used to service a 5700A independently.

WARNING

SERVICING DESCRIBED IN THIS MANUAL IS TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SPECIFICATIONS 1-3.

The following tables provide specifications for the 5700A, including operation with the Wideband AC Module (Option 5700A-03) and the 5725A Amplifier.

Specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5700A has been turned off. For example, if the 5700A has been turned off for five minutes, the warm-up period is ten minutes.

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A Absolute Uncertainty specifications. Absolute uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability to external standards. You do not need to add anything to absolute uncertainty to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

Relative Uncertainty specifications are provided for enhanced accuracy applications. These specifications apply when range constants are adjusted (see “Range Calibration”). To calculate absolute uncertainty, you must combine the uncertainties of your external standards and techniques with relative uncertainty.

Secondary Performance Specifications and Operating Characteristics are included in uncertainty specifications. They are provided for special calibration requirements such as stability or linearity testing.

DC Voltage

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		±(ppm output + μV)				±(ppm output + μV)	
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8	2.5 + .5	4 + .5
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2	2.5 + 1.2	4 + 1.2
11V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4	1.5 + 3	3.5 + 4
22V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8	1.5 + 6	3.5 + 8
220V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100	2.5 + 100	4 + 100
1100V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600	3 + 600	4.5 + 600

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Stability ±1°C 24 Hours	Temperature Coefficient [Note]		Linearity ±1°C	Noise	
		10°-40°C	0°-10°C and 40°-50°C		Bandwidth 0.1-10 Hz	Bandwidth 10-10 kHz
					pk-pk	RMS
	±(ppm output + μV)	±(ppm output + μV)/°C		±(ppm output + μV)		μV
220 mV	.3 + .3	.4 + .1	1.5 + .5	1 + .2	.15 + .1	5
2.2V	.3 + 1	.3 + .1	1.5 + 2	1 + .6	.15 + .4	15
11V	.3 + 2.5	.15 + .2	1 + 1.5	.3 + 2	.15 + 2	50
22V	.4 + 5	.2 + .4	1.5 + 3	.3 + 4	.15 + 4	50
220V	.5 + 40	.3 + 5	1.5 + 40	1 + 40	.15 + 60	150
1100V	.5 + 200	.5 + 10	3 + 200	1 + 200	.15 + 300	500

Note: Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operating more than ±5°C from calibration temperature.

Minimum output: 0V for all ranges, except 100V for 1100V range

Maximum load: 50 mA for 2.2V through 220V ranges; 20 mA for 1100V range; 50Ω output impedance on 220 mV range; all ranges <1000 pF, >25Ω

Load regulation: <0.2 ppm + 0.2 μV change, full load to no load

Line regulation: <0.1 ppm change, ±10% of selected nominal line

Settling time: 3 seconds to full accuracy; +1 second for range or polarity change; +1 second for 1100V range

Overshoot: <5%

Common mode rejection: 140 dB, DC to 400 Hz

Remote sensing: Available 0V to ±1100V, on 2.2V through 1100V ranges

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	±(ppm output + µV)				±(ppm output + µV)	
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5	500 + 5	550 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5	200 + 5	220 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5	60 + 5	65 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5	100 + 5	110 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15	400 + 15	440 + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30	.10% + 30	.11% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30	.3% + 30	.33% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6	500 + 6	550 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6	200 + 6	220 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6	60 + 6	65 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6	100 + 6	110 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15	400 + 15	440 + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30	.10% + 30	.11% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30	.3% + 30	.33% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16	500 + 16	550 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10	200 + 10	220 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10	60 + 10	65 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10	100 + 10	110 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30	220 + 30	240 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30	400 + 30	440 + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40	.1% + 40	.11% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100	.3% + 100	.33% + 100
2.2V	1 µV	10-20	500 + 100	550 + 100	600 + 100	600 + 100	500 + 100	550 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30	150 + 30	170 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7	40 + 7	45 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20	100 + 20	110 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80	200 + 80	220 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150	400 + 150	440 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400	.1% + 400	.11% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV	.2% + 1 mV	.22% + 1 mV
22V	10 µV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV	500 + 1 mV	550 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300	150 + 300	170 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70	40 + 70	45 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200	100 + 200	110 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400	200 + 400	220 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV	500 + 1.7 mV	550 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV	.12% + 5 mV	.13% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV	.26% + 9 mV	.28% + 9 mV
			±(ppm output + mV)				±(ppm output + mV)	
220V	100 µV	10-20	500 + 10	550 + 10	600 + 10	600 + 10	500 + 10	550 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3	150 + 3	170 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1	45 + 1	50 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4	100 + 1	110 + 1
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10	300 + 10	330 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110	.15% + 110	.15% + 100
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110	.50% + 110	.52% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220	1.20% + 220	1.20% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
5725A Amplifier:								
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45	380 + 45	.12% + 45

AC Voltage (continued)

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient		Output Impedance	Maximum Distortion Bandwidth 10 Hz-10 MHz
			10°-40°C	0°-10°C and 40°-50°C		
	Hz	±μV	±μV/°C		Ω	±(% output + μV)
2.2 mV	10-20	5	.05	.05	50	.05 + 10
	20-40	5	.05	.05		.035 + 10
	40-20k	2	.05	.05		.035 + 10
	20k-50k	2	.1	.1		.035 + 10
	50k-100k	3	.2	.2		.035 + 10
	100k-300k	3	.3	.3		.3 + 30
	300k-500k	5	.4	.4		.3 + 30
	500k-1M	5	.5	.5		1 + 30
22 mV	10-20	5	.2	.3	50	.05 + 11
	20-40	5	.2	.3		.035 + 11
	40-20k	2	.2	.3		.035 + 11
	20k-50k	2	.4	.5		.035 + 11
	50k-100k	3	.5	.5		.035 + 11
	100k-300k	5	.6	.6		.3 + 30
	300k-500k	10	1	1		.3 + 30
	500k-1M	15	1	1		1 + 30
		±(ppm output + μV)	±(ppm output + μV)/°C			
220 mV	10-20	150 + 20	2 + 1	2 + 1	50	.05 + 16
	20-40	80 + 15	2 + 1	2 + 1		.035 + 16
	40-20k	12 + 2	2 + 1	2 + 1		.035 + 16
	20k-50k	10 + 2	15 + 2	15 + 2		.035 + 16
	50k-100k	10 + 2	15 + 4	15 + 4		.035 + 16
	100k-300k	20 + 4	80 + 5	80 + 5		.3 + 30
	300k-500k	100 + 10	80 + 5	80 + 5		.3 + 30
	500k-1M	200 + 20	80 + 5	80 + 5		1 + 30
					Load Regulation ±(ppm output + μV)	
2.2V	10-20	150 + 20	50 + 10	50 + 10	10 + 2	.05 + 80
	20-40	80 + 15	15 + 5	15 + 5	10 + 2	.035 + 80
	40-20k	12 + 4	2 + 1	5 + 2	10 + 4	.035 + 80
	20k-50k	15 + 5	10 + 2	15 + 4	30 + 10	.035 + 80
	50k-100k	15 + 5	10 + 4	20 + 4	120 + 16	.035 + 80
	100k-300k	30 + 10	80 + 15	80 + 15	300 ppm	.3 + 110
	300k-500k	70 + 20	80 + 40	80 + 40	600 ppm	.3 + 110
	500k-1M	150 + 50	80 + 100	80 + 100	.12%	1 + 110
22V	10-20	150 + 20	50 + 100	50 + 100	10 + 20	.05 + 700
	20-40	80 + 15	15 + 30	15 + 40	10 + 20	.035 + 700
	40-20k	12 + 8	2 + 10	4 + 15	10 + 30	.035 + 700
	20k-50k	15 + 10	10 + 20	20 + 20	30 + 50	.035 + 700
	50k-100k	15 + 10	10 + 40	20 + 40	80 + 80	.035 + 700
	100k-300k	30 + 15	80 + 150	80 + 150	100 + 700	.3 + 800
	300k-500k	70 + 100	80 + 300	80 + 300	200 + 1.1 mV	.3 + 800
	500k-1M	150 + 100	80 + 500	80 + 500	600 + 3.0 mV	2 + 800
220V	10-20	150 + 200	50 + 1 mV	50 + 1 mV	10 + .2 mV	.05 + 10 mV
	20-40	80 + 150	15 + 300	15 + 300	10 + .2 mV	.05 + 10 mV
	40-20k	12 + 80	2 + 80	4 + 80	10 + .3 mV	.05 + 10 mV
	20k-50k	15 + 100	10 + 100	20 + 100	30 + .6 mV	.05 + 10 mV
	50k-100k	15 + 100	10 + 500	20 + 500	80 + 3 mV	.1 + 13 mV
	100k-300k	30 + 400	80 + 600	80 + 600	250 + 25 mV	1.5 + 50 mV
	300k-500k	100 + 10 mV	80 + 800	80 + 800	500 + 50 mV	1.5 + 50 mV
	500k-1M	200 + 20 mV	80 + 1 mV	80 + 1 mV	1000 + 110 mV	3.5 + 100 mV
		±(ppm output + mV)	±(ppm output)/°C			±(% output)
1100V	50-1k	20 + .5	2	5	10 + 1	.07

AC Voltage (continued)

Secondary Performance and Operating Characteristics (continued)

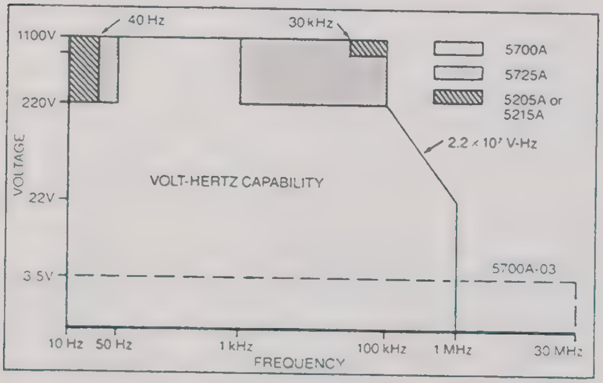
Included in Uncertainty Specifications

5725A Amplifier:

Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient		Load Regulation [Note 2]	Distortion Bandwidth 10 Hz-10 MHz	
			10°-40°C	0°-10°C and 40°-50°C			
	Hz	±(ppm output + mV)	±(ppm output)/°C		±(ppm output + mV)	±(% output)	
						150 pF	1000 pF
1100V	40-1k	10 + .5	5	5	10 + 1	.10	.10
	1k-20k	15 + 2	5	5	90 + 6	.10	.15
	20k-50k	40 + 2	10	10	275 + 11	.30	.30
	50k-100k	130 + 2	30	30	500 + 30	.40	.40

Voltage Range	Maximum Current Limits		Load Limits
2.2V [Note 1] 22V 220V	50 mA, 0°C-40°C 20 mA, 40°C-50°C		>50Ω, 1000 pF
1100V	6 mA		600 pF
5725A Amplifier:			1000 pF [Note 2]
1100V	40 Hz-5 kHz	50 mA	300 pF
	5 kHz-30 kHz	70 mA	
	30 kHz-100 kHz	70 mA [Note 3]	150 pF

Notes:
1. 2.2V Range, 100 kHz-1.2 MHz only: uncertainty specifications cover loads to 10 mA or 1000 pF. For higher loads, load regulation is added
2. The 5725A will drive up to 1000 pF of load capacitance. Uncertainty specifications include loads to 300 pF and 150 pF as shown under "Load Limits." For capacitances up to the maximum of 1000 pF, add "Load Regulation."
3. Applies from 0°C to 40°C.



Output display formats: Voltage or dBm, dBm reference 600Ω.

Minimum output: 10% on each range

External sense: Selectable for 2.2V, 22V, 220V, and 1100V ranges; 5700A <100 kHz, 5725A <30 kHz

Settling time to full accuracy:

Frequency (Hz)	Settling time (seconds)
<120	7
120-120k	5
>120k	2

+1 second for amplitude or frequency range change; +2 seconds for 5700A 1100V range; + 4 seconds for 5725A 1100V range

Overshoot: <10%

Common mode rejection: 140 dB, DC to 400 Hz

Frequency:

Ranges (Hz):
10.000 - 11.999, 12.00 - 119.99
120.0 - 1199.9, 1.200k - 11.999k
12.00k - 119.99k, 120.0k - 1.1999M
Uncertainty: ±0.01%
Resolution: 11,999 counts

Phase lock: Selectable rear panel BNC input
Phase uncertainty (except 1100V range):
>30 Hz: ±(1° + 0.05°/kHz), <30 Hz: ±3°
Input voltage: 1V to 10V rms sine wave (do not exceed 1V for mV ranges)
Frequency range: 10 Hz to 1.1999 MHz
Lock range: ±2% of frequency
Lock-in time: Larger of 10/frequency or 10 msec

Phase reference: Selectable, rear panel BNC output
Range: ±180°
Phase Uncertainty (except 1100V range):
±1° at quadrature points (0°, ±90°, ±180°) elsewhere ±2°
Stability: ±0.1°
Resolution: 1°
Output level: 2.5V rms ±0.2V
Frequency range: 50 Hz to 1 kHz, useable 10 Hz to 1.1999 MHz

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from calibration temperature [Note 1]				Relative Uncertainty ±1°C	
	24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
Ω	±ppm				±ppm	
0	50 µΩ	50 µΩ	50 µΩ	50 µΩ	50 µΩ	50 µΩ
1	85	95	100	110	32	40
1.9	85	95	100	110	25	33
10	26	28	30	33	5	8
19	24	26	28	31	4	7
100	15	17	18	20	2	4
190	15	17	18	20	2	4
1k	11	12	13	15	2	3.5
1.9k	11	12	13	15	2	3.5
10k	9	11	12	14	2	3.5
19k	9	11	12	14	2	3.5
100k	11	13	14	16	2	3.5
190k	11	13	14	16	2	3.5
1M	16	18	20	23	2.5	5
1.9M	17	19	21	24	3.5	6
10M	33	37	40	46	10	14
19M	43	47	50	55	20	24
100M	110	120	125	130	50	60

Secondary Performance Specifications and Operating Characteristics
Included in Uncertainty Specifications

Nominal Value	Stability ±1°C	Temperature Coefficient [Note 2]		Full Spec Load Range [Note 3]	Maximum Peak Current	Maximum Difference of Characterized to Nominal Value	Two-Wire Adder active compensation [Note 4]	
							Lead Resistance	
	24 Hours	10°-40°C	0°-10°C and 40°-50°C				0.1Ω	1Ω
Ω	±ppm	±ppm/°C		mA	mA	±ppm	±mΩ	
0	—	—	—	8-500	500	—	2	4
1	32	4	5	8-100	700	500	2	4
1.9	25	6	7	8-100	500	500	2	4
10	5	2	3	8-11	220	300	2	4
19	4	2	3	8-11	160	300	2	4
100	2	2	3	8-11	70	150	2	4
190	2	2	3	8-11	50	150	2	4
1k	2	2	3	1-2	22	150	10	15
1.9k	2	2	3	1-1.5	16	150	10	15
10k	2	2	3	100-500 µA	7	150	50	60
19k	2	2	3	50-250 µA	5	150	100	120
100k	2	2	3	10-100 µA	1	150		
190k	2	2	3	5-50 µA	500 µA	150		
1M	2.5	2.5	6	5-20 µA	100 µA	200		
1.9M	3.5	3	10	2.5-10 µA	50 µA	200		
10M	10	5	20	.5-2 µA	10 µA	300		
19M	20	8	40	.25-1 µA	5 µA	300		
100M	50	12	100	50-200 nA	1 µA	500		

Notes:

1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ.
2. Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operated more than 5°C from calibration temperature, or calibrated outside the range 19°C to 24°C. Two examples:
   a) Calibrate at 20°C: Temperature coefficient adder is not required unless operated below 15°C or above 25°C.
   b) Calibrate at 26°C: Add 2°C temperature coefficient adder. Additional temperature coefficient adder is not required unless operated below 21°C or above 31°C.
3. Refer to current derating factors table for loads outside of this range.
4. Active two-wire compensation may be selected for values less than 100 kΩ, with either the front panel *or the meter input terminals* as reference plane. Active compensation is limited to 11 mA load, and to 2V burden. Two wire compensation can be used only with Ω meters that source continuous (not pulsed) dc current.

Current Derating Factors

Nominal Value	Value of Derating Factor K for Over or Under Current		
Ω	Two-Wire Comp $I<I_L$ (Note 1)	Four-Wire $I<I_L$ (Note 1)	Four-Wire $I_U<I<I_{MAX}$ (Note 2)
SHORT	4.4	0.3	—
1	4.4	300	4×10^{-5}
1.9	4.4	160	1.5×10^{-4}
10	4.4	30	1.6×10^{-3}
19	4.4	16	3×10^{-3}
100	4.4	3.5	1×10^{-2}
190	4.4	2.5	1.9×10^{-2}
1k	4.4	0.4	0.1
1.9k	4.4	0.4	0.19
10k	5000	50	2.0
19k	5000	50	3.8
100k	—	7.5	2×10^{-5}
190k	—	4.0	3.8×10^{-5}
1M	—	1.0	1.5×10^{-4}
1.9M	—	0.53	2.9×10^{-4}
10M	—	0.2	1×10^{-3}
19M	—	0.53	1.9×10^{-3}
100M	—	0.1	—

Notes:

1. For $I<I_L$, errors occur due to thermally generated voltages within the 5700A. Use the following equation to determine the error, and add this error to the corresponding UNCERTAINTY or STABILITY specification.

   $\text{Error} = K(I_L - I)/(I_L \times I)$

   Where: Error is in mΩ for all TWO-WIRE COMP values and FOUR-WIRE SHORT, and in ppm for the remaining FOUR-WIRE values.
   K is the constant from the above table;
   I and I_L are expressed in mA for SHORT to 1.9 kΩ;
   I and I_L are expressed in μA for 10 kΩ to 100 MΩ

2. For $I_U<I<I_{MAX}$ errors occur due to self-heating of the resistors in the 5700A. Use the following equation to determine the error in ppm, and add this error to the corresponding UNCERTAINTY or STABILITY specification.

   $\text{Error in ppm} = K(I^2 - I_U^2)$

   Where: K is the constant from the above table;
   I and I_U are expressed in mA for SHORT to 19 kΩ;
   I and I_U are expressed in μA for 100 kΩ to 100 MΩ

DC Current

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature			
		24 Hours	90 Days	180 Days	1 Year
	nA	±(ppm output + nA)			
220 μA	.1	45 + 10	50 + 10	55 + 10	60 + 10
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100
	μA	±(ppm output + μA)			
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1
2.2A [Note 1]	1	75 + 30	80 + 30	90 + 30	95 + 30
5725A Amplifier:					
11A	10	330 + 470	340 + 480	350 + 480	360 + 480

Relative Uncertainty ±1°C	
24 Hours	90 Days
±(ppm output + nA)	
24 + 2	26 + 2
24 + 5	26 + 5
24 + 50	26 + 50
±(ppm output + μA)	
26 + .3	30 + .3
40 + 7	45 + 7
100 + 130	110 + 130

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Stability ±1°C	Temperature Coefficient [Note 2]		Compliance Limits	Burden Voltage Adder [Note 3]	Maximum Load For Full Accuracy [Note 4]	Noise	
	24 Hours	10°-40°C	0°-10°C and 40°-50°C				Bandwidth 0.1-10 Hz	Bandwidth 10-10 kHz
							pk-pk	RMS
	±(ppm output + nA)	±(ppm output + nA)/°C		V	±nA/V	Ω	ppm output + nA	nA
220 μA	5 + 1	1 + .40	3 + 1	10	.2	20k	6 + .9	10
2.2 mA	5 + 5	1 + 2	3 + 10	10	.2	2k	6 + 5	10
22 mA	5 + 50	1 + 20	3 + 100	10	10	200	6 + 50	50
220 mA	8 + 300	1 + 200	3 + 1 μA	10	100	20	9 + 300	500
2.2A	9 + 7 μA	1 + 2.5 μA	3 + 10 μA	3 [Note 5]	2 μA	2	12 + 1.5 μA	20 μA
5725A:	±(ppm output + μA)	±(ppm output + μA)/°C					ppm output + μA	μA
11A	25 + 100	20 + 75	30 + 120	4	0	4	15 + 70	175

Notes:

Maximum output from 5700A terminals is 2.2A. Uncertainty specifications for 220 μA and 2.2 mA ranges are increased by 1.3 × when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Add to uncertainty specifications:
   ± 200 × I^2 ppm for >100 mA on 220 mA range
   ± 10 × I^2 ppm for >1A on 2.2A range
2. Temperature coefficient is an adder to uncertainty specifications. It does *not* apply unless operating more than ± 5°C from calibration temperature.
3. Burden voltage adder is an adder to uncertainty specifications that does *not* apply unless burden voltage is greater than 0.5V.
4. For higher loads, multiply uncertainty specification by:

$$1 + \frac{0.1 \times \text{actual load}}{\text{maximum load for full accuracy}}$$

5. 5700A compliance limit is 2V for outputs from 1A to 2.2A. 5725A Amplifier may be used in range-lock mode down to 0A.

Minimum output: 0 for all ranges, including 5725A.

Settling time to full accuracy: 1 second for μA and mA ranges; 3 seconds for 2.2A range; 6 seconds for 11A range; + 1 second for range or polarity change

Overshoot: <5%

AC Current

Range	Resolution	Frequency	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	±(ppm output + nA)				±(ppm output + nA)	
220 μA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30	450 + 30	500 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25	270 + 25	300 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20	110 + 20	120 + 20
		1k-5k	500 + 50	600 + 50	650 + 50	700 + 50	450 + 50	500 + 50
		5k-10k	.15% + 100	.16% + 100	.17% + 100	.18% + 100	.14% + 100	.15% + 100
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50	450 + 50	500 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40	270 + 40	300 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40	110 + 40	120 + 40
		1k-5k	500 + 500	600 + 500	650 + 500	700 + 500	450 + 500	500 + 500
		5k-10k	.15% + 1 μA	.16% + 1 μA	.17% + 1 μA	.18% + 1 μA	.14% + 1 μA	.15% + 1 μA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500	450 + 500	500 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400	270 + 400	300 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400	110 + 400	120 + 400
		1k-5k	500 + 5 μA	600 + 5 μA	650 + 5 μA	700 + 5 μA	450 + 5 μA	500 + 5 μA
		5k-10k	.15% + 10 μA	.16% + 10 μA	.17% + 10 μA	.18% + 10 μA	.14% + 10 μA	.15% + 10 μA
		Hz	+(ppm output + μA)				+(ppm output + μA)	
220 mA	1 μA	10-20	650 + 5	700 + 5	750 + 5	800 + 5	450 + 5	500 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4	280 + 4	300 + 4
		40-1k	120 + 4	150 + 4	170 + 4	180 + 4	110 + 4	130 + 4
		1k-5k	500 + 50	600 + 50	650 + 50	700 + 50	450 + 50	500 + 50
		5k-10k	.15% + 100	.16% + 100	.17% + 100	.18% + 100	.14% + 100	.15% + 100
2.2A	10 μA	20-1k	600 + 40	650 + 40	700 + 40	750 + 40	600 + 40	650 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100	650 + 100	750 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200	.75% + 200	.85% + 200
5725A Amplifier:								
11A	100 μA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750	.28% + 750	.32% + 750

AC Current (continued)

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient [Note 1]		Compliance Limits	Maximum Resistive Load For Full Accuracy [Note 2]	Noise and Distortion
			10°-40°C	0°-10°C and 40°-50°C			Bandwidth 10 Hz-50 kHz <0.5V Burden
	Hz	±(ppm output + nA)	±(ppm output + nA)/°C		V rms	Ω	±(% output + μA)
220 μA	10-20	150 + 5	50 + 5	50 + 5	7	2k	.05 + .1
	20-40	80 + 5	20 + 5	20 + 5			.05 + .1
	40-1k	30 + 3	4 + .5	10 + .5			.05 + .1
	1k-5k	50 + 20	10 + 1	20 + 1			.25 + .5
	5k-10k	400 + 100	20 + 100	20 + 100			.5 + 1
2.2 mA	10-20	150 + 5	50 + 5	50 + 5	7	500	.05 + .1
	20-40	80 + 5	20 + 4	20 + 4			.05 + .1
	40-1k	30 + 3	4 + 1	10 + 2			.05 + .1
	1k-5k	50 + 20	10 + 100	20 + 100			.25 + .5
	5k-10k	400 + 100	50 + 400	50 + 400			.5 + 1
22 mA	10-20	150 + 50	50 + 10	50 + 10	7	150	.05 + .1
	20-40	80 + 50	20 + 10	20 + 10			.05 + .1
	40-1k	30 + 30	4 + 10	10 + 20			.05 + .1
	1k-5k	50 + 500	10 + 500	20 + 400			.25 + .5
	5k-10k	400 + 1 μA	50 + 1 μA	50 + 1 μA			.5 + 1
	Hz	±(ppm output + μA)	±(ppm output + μA)/°C				
220 mA	10-20	150 + .5	50 + .05	50 + .05	7	15	.05 + 10
	20-40	80 + .5	20 + .05	20 + .05			.05 + 10
	40-1k	30 + .3	4 + .1	10 + .1			.05 + 10
	1k-5k	50 + 3	10 + 2	20 + 2			.25 + 50
	5k-10k	400 + 5	50 + 5	50 + 5			.5 + 100
2.2A	20-1k	50 + 5	4 + 1	10 + 1	1.4 [Note 3]	.5	.5 + 100
	1k-5k	80 + 20	10 + 5	20 + 5			.3 + 500
	5k-10k	800 + 50	50 + 10	50 + 10			1 + 1 mA
5725A Amplifier:							±(% output)
11A	40-1k	75 + 100	20 + 75	30 + 75	3	3	[Note 4] .05
	1k-5k	100 + 150	40 + 75	50 + 75			.12
	5k-10k	200 + 300	100 + 75	100 + 75			.5

Notes:

Maximum output from 5700A terminals is 2.2A. Uncertainty specifications for 220 μA and 2.2 mA ranges are increased by 1.3 x plus 2 μA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operating more than ±5°C from calibration temperature.

2. For larger resistive loads multiply uncertainty specifications by:

$$\left(\frac{\text{actual load}}{\text{maximum load for full accuracy}}\right)^2$$

3. 1.5V compliance limit above 1A. 5725A Amplifier may be used in range-lock mode down to 1A.

4. For resistive loads within rated compliance voltage limits.

Minimum output: 9 μA for 220 μA range, 10% on all other ranges. 1A minimum for 5725A.

Inductive load limits: 400 μH (5700A or 5725A). 20 μH for 5700A output >1A.

Power factors: 5700A, 0.9 to 1; 5725A, 0.1 to 1. Subject to compliance voltage limits.

Frequency:

Range (Hz):
10.000 - 11.999, 12.00 - 119.99,
120.0 - 1199.9, 1.200k - 10.000k
Uncertainty: ± 0.01%
Resolution: 11,999 counts

Setting time to full accuracy: 5 seconds for 5700A ranges; 6 seconds for 5725A 11A range; +1 second for amplitude or frequency range change.

Overshoot: <10%

Wideband AC Voltage (Option -03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty ±5°C from calibration temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + µV)			
1.1 mV	−46	10 nV	.4 + .4	.5 + .4	.6 + .4	.8 + 2
3 mV	−37	10 nV	.4 + 1	.45 + 1	.5 + 1	.7 + 3
11 mV	−26	100 nV	.2 + 4	.35 + 4	.5 + 4	.7 + 8
33 mV	−17	100 nV	.2 + 10	.3 + 10	.45 + 10	.6 + 16
110 mV	−6.2	1 µV	.2 + 40	.3 + 40	.45 + 40	.6 + 40
330 mV	+3.4	1 µV	.2 + 100	.25 + 100	.35 + 100	.5 + 100
1.1V	+14	10 µV	.2 + 400	.25 + 400	.35 + 400	.5 + 400
3.5V	+24	10 µV	.15 + 500	.2 + 500	.3 + 500	.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference			Temperature Coefficient	Settling Time To Full Accuracy	Harmonic Distortion
		Voltage Range					
		1.1 mV	3 mV	>3 mV			
Hz	Hz	±%			±ppm/°C	Seconds	dB
10-30	.01	.3	.3	.3	100	7	−40
30-120	.01	.1	.1	.1	100	7	−40
120-1.2k	.1	.1	.1	.1	100	5	−40
1.2k-12k	1	.1	.1	.1	100	5	−40
12k-120k	10	.1	.1	.1	100	5	−40
120k-1.2M	100	.2 + 3 µV	.1 + 3 µV	.1 + 3 µV	100	5	−40
1.2M-2M	100k	.2 + 3 µV	.1 + 3 µV	.1 + 3 µV	100	0.5	−40
2M-10M	100k	.4 + 3 µV	.3 + 3 µV	.2 + 3 µV	100	0.5	−40
10M-20M	1M	.6 + 3 µV	.5 + 3 µV	.4 + 3 µV	150	0.5	−34
20M-30M	1M	1.5 + 15 µV	1.5 + 3 µV	1 + 3 µV	300	0.5	−34

Additional Operating Information:

dBm reference = 50Ω

Range boundaries are at voltage points, dBm levels are approximate.

$\text{dBm} = 10 \log \left(\frac{\text{Power}}{1\ \text{mW}} \right)$,

0.22361V across 50Ω = 1 mW or 0 dBm

Minimum output: 300 µV (−57 dBm)

Frequency uncertainty: ±0.01%

Frequency resolution: 11,999 counts to 1.1999 MHz, 119 counts to 30 MHz.

Overload protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications:

Warm-up time: 2 × the time since last warmed up, to a maximum of 30 minutes.

System installation: Rear output configuration and rack-mount kit available.

Standard interfaces: IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).

Temperature performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: −40°C to 75°C

Relative humidity: Operating: <80% to 30°C, <70% to 40°C, <40% to 50°C. Storage: <95%, non-condensing

Safety: Designed to comply with UL1244 (1987); IEC 348-1978; IEC 66E (CO) 4; CSA 556B.

Guard isolation: 20 volts

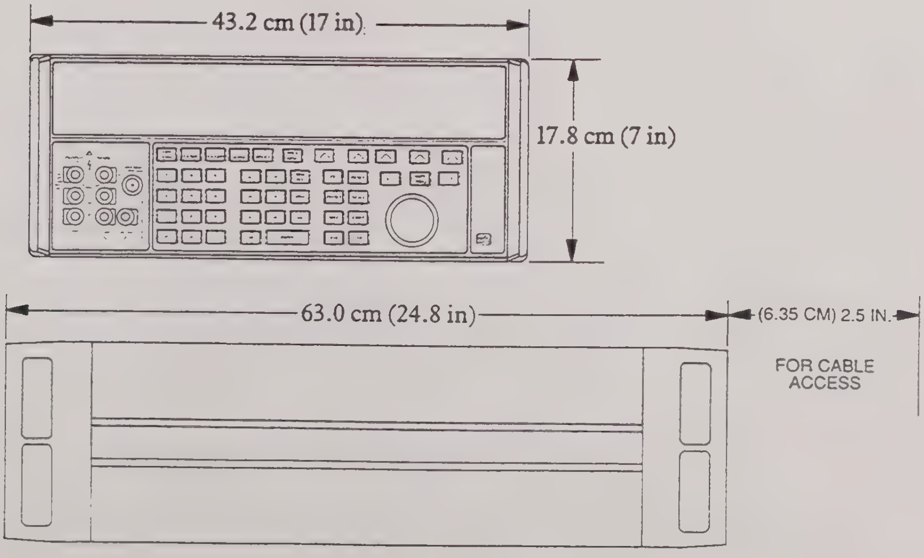
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B.

Reliability: MIL-T-28800D, para. 3.13.3.

Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V. Maximum power: 5700A, 300VA; 5725A, 750VA.

Size:
5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 63.0 cm (24.8 in), overall; 57.8 cm (22.7 in), rack depth.
5725A: Height 13.3 cm (5.25 in); Width and depth same as 5700A. Both units project 5.1 cm (2 in) from rack front.

Weight: 5700A: 27kg (62 lbs); 5725A: 32kg (70 lbs).



Auxiliary Amplifier Specifications

Note: See 5205A and 5220A Instruction Manuals for complete specifications.

5205A (220V - 1100V ac, 0V - 1100V dc)

Overshoot: < 10%.

Distortion (bandwidth 10 Hz - 1 MHz):

10 Hz - 20 kHz	.07%
20 kHz - 50 kHz	.2%
50 kHz - 100 kHz	.25%

Frequency	90 Day Accuracy at 23°±5°C ±(% output + % range)	Temperature Coefficient for 0°- 18°C and 28°- 50°C ±(ppm output + ppm range)/°C
DC	0.05 + 0.005	15 + 3
10 Hz - 40 Hz	0.15 + 0.005	45 + 3
40 Hz - 20 kHz	0.04 + 0.004	15 + 3
20 kHz - 50 kHz	0.08 + 0.006	50 + 10
50 kHz - 100 kHz	0.1+ 0.01	70 + 20

5220A (AC Current, 180-day specifications):

Accuracy:

20 Hz - 1 kHz	.07% + 1 mA
1 kHz - 5 kHz	(.07% + 1 mA) x frequency in kHz

Temperature Coefficient (0°-18°C and 28°-50°C): (.003% + 100 μA)/°C

Distortion (bandwidth 300 kHz):

20 Hz - 1 kHz	.1% + 1 mA
1 kHz - 5 kHz	(.1% + 1 mA) x frequency in kHz

Note: 5700A/5220A combination is not specified for inductive loads.

Section 2

Theory of Operation

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INTRODUCTION 2-1.

This section provides theory of operation in increasing level of detail. The calibrator is first broadly defined in terms of digital functions (relating to the Digital Motherboard assembly) and analog functions (relating to the Analog Motherboard assembly). The interrelationship of these two areas is then explored in discussions of each output function. Finally, the overall picture is rounded out with a discussion of system interconnections.

Most of this section is devoted to detailed circuit descriptions, first of in the digital (unguarded) section, then in the analog (guarded) section.

CALIBRATOR OVERVIEW 2-2.

Figures 2-1, 2-2, and 2-3 comprise the block diagram of the 5700A. These figures are presented further on in the Analog Section Overview and the Digital Section Overview.

The 5700A is configured internally as an automated calibration system with process controls and consistent procedures. Internal microprocessors control all functions and monitor performance, using a switching matrix to route signals between modules. Complete automatic internal diagnostics, both analog and digital, confirm operational integrity.

The heart of the measurement system is a 5 1/2-digit adc (analog-to-digital converter), which is used in a differential mode with the 5700A dac. (The dac is described next under "Internal References.")

Internal References 2-3.

The major references that form the basis of the 5700A's accuracy are the hybrid reference amplifiers, patented Fluke solid-state thermal rms sensors, an extremely linear dac, and two internal precision resistors.

HYBRID REFERENCE AMPLIFIERS 2-4.

A precision source can only be as accurate as its internal references, so the dc voltage reference for the 5700A was chosen with extreme care. Years of data collection have proven the ovenized reference amplifier to be the best reference device available for modern, ultra-stable voltage standards.

In a microprocessor-controlled precision instrument such as the 5700A, the important characteristics of its dc voltage references are not the accuracy of the value of the references, but rather their freedom from drift and hysteresis. (Hysteresis is the condition of stabilizing at a different value after being turned off then on again.) The 5700A hybrid reference amplifiers excel in both freedom from drift and absence of hysteresis.

FLUKE THERMAL SENSOR (FTS) 2-5.

Thermal rms sensors, or ac converters, convert ac voltage to dc voltage with great accuracy. These devices sense true rms voltage by measuring the heat generated by a voltage through a known resistance.

Conventional thermal voltage converters suffer from two main sources of error. First, they exhibit frequency response errors caused by component reactance. Second, they have a poor signal-to-noise ratio because they operate at the millivolt level. The FTS has a full-scale input and output of 2V and a flat frequency response.

After initial functional verification of the Fluke Thermal Sensors, their characteristics only change by less than 1/10th of the allowed ac/dc error per year. External calibration of the ac voltage function of the 5700A consists of verifying that the 5700A meets its specifications.

DIGITAL-TO-ANALOG CONVERTER (DAC) 2-6.

A patented 26-bit dac is used in the calibrator as a programmable voltage divider. The dac is a pulse-width modulated (pwm) type with linearity better than 1 ppm (part-per-million) from 1/10th scale to full scale.

DIGITAL SECTION OVERVIEW 2-7.

The unguarded Digital Section contains the CPU assembly (A20), Digital Power Supply assembly (A19), Front Panel assembly (A2), Keyboard assembly (A1), and the unguarded portion of the Rear Panel assembly (A21). Figure 2-1 is a block diagram of the digital section of the 5700A.

Power for the digital assemblies and the cooling fans is supplied by the Digital Power Supply assembly.

The CPU (central processing unit) assembly is a single-board computer based on the 68HC000 microprocessor. It controls local and remote interfaces, as well as serial communications over a fiber-optic link to the crossing portion of the Regulator/Guard Crossing assembly (A17). The guard crossing controls the guarded analog circuitry.

A Keyboard assembly provides the user with front-panel control of the 5700A. It contains four LED's, a rotary edit knob, and a forty-five key keypad. It connects to the Front Panel assembly via a cable.

The Front Panel assembly provides information to the user on an Output Display and a Control Display. The Front Panel also contains circuitry that scans the keyboard and encodes key data for the CPU.

The Rear Panel assembly includes digital interfaces for the following:

- IEEE-488 bus connection
- RS-232-C DTE serial port
- Four auxiliary amplifiers: the 5725A, 5205A, 5215A, and 5220A

ANALOG SECTION OVERVIEW 2-8.

The guarded analog section of the 5700A contains the following assemblies:

- Wideband Output (A5) (Part of Option -03)
- Wideband Oscillator (A6) (Part of Option -03)
- Current/Hi-Res (A7)
- Switch Matrix (A8)
- Ohms Cal (A9)
- Ohms (A10)
- DAC (A11)
- Oscillator Control (A12)
- Oscillator Output (A13)
- High Voltage Control (A14)
- High Voltage/High Current (A15)
- Power Amplifier (A16)
- Regulator/Guard Crossing (A17)
- Filter/PA Supply (A18)

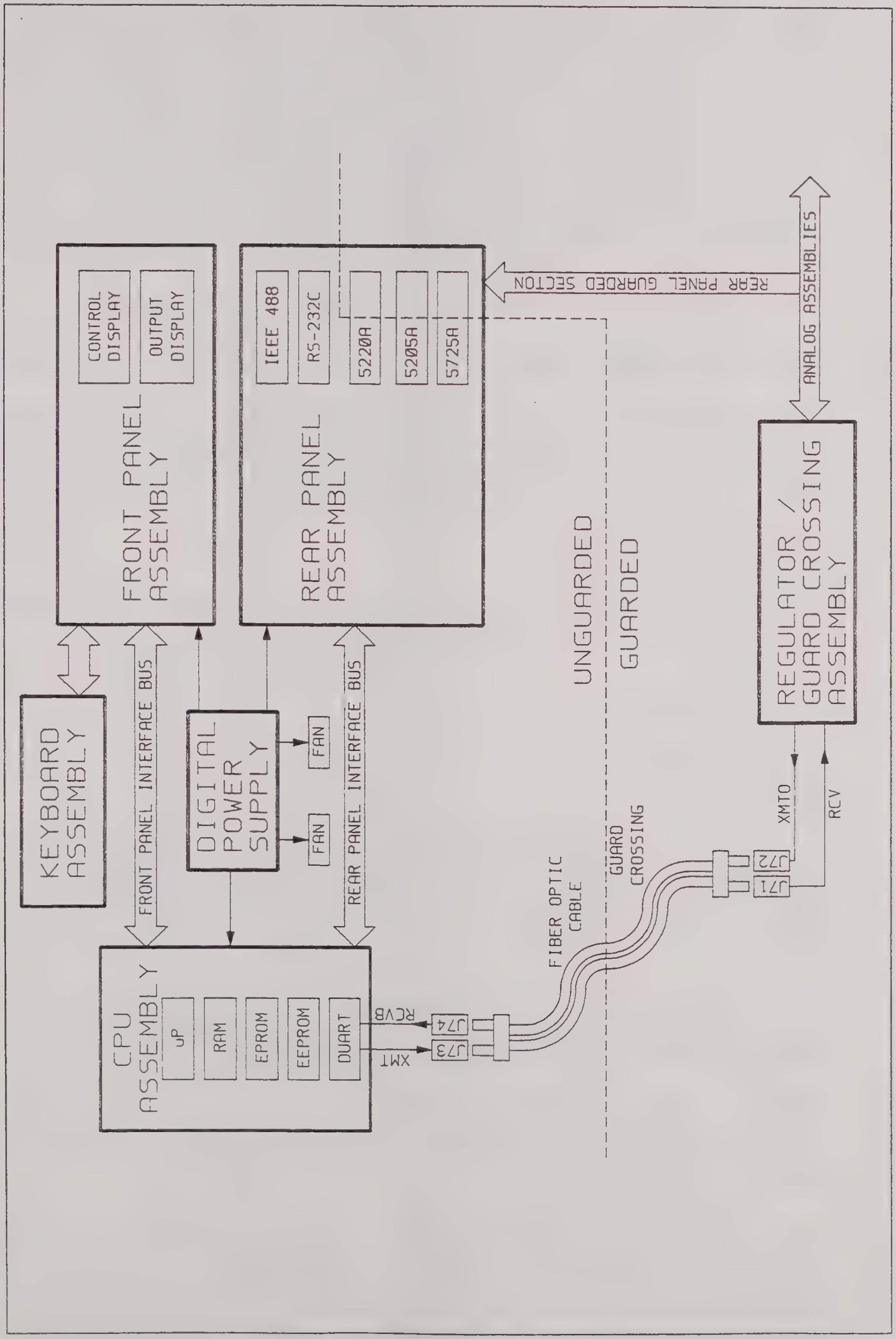


Figure 2-1. Digital Section Block Diagram

These analog assemblies are interfaced to the Analog Motherboard assembly (A3). The guarded digital bus generated by the guard crossing portion of the Regulator/Guard Crossing assembly controls all analog assemblies except the Filter/PA Supply. The Guard Crossing interfaces with the unguarded CPU assembly via a fiber-optic link. The Transformer assembly, along with the filter portion of the Filter/PA Supply assembly and the regulator portion of the Regulator/Guard Crossing assembly, create the system power supply for all the analog assemblies. The Power Amplifier Supply portion of the Filter/PA Supply assembly provides the high voltage power supplies required by the Power Amplifier assembly. The amplitudes of these high voltage supplies are controlled by circuitry contained on the Power Amplifier assembly.

Figures 2-2 and 2-3 are block diagrams for the analog section of the 5700A.

FUNCTIONAL DESCRIPTION PRESENTED BY OUTPUT FUNCTION 2-9.

This part of the theory section presents 5700A operation from the perspective of each output function. It describes which assemblies come into play, and how they interact. It does not provide a detailed circuit description. Refer to the individual assembly theories further on in this section for detailed circuit descriptions.

DC Voltage Functional Description 2-10.

The DAC assembly (A11) provides a stable dc voltage and is the basic building block of the 5700A. DC voltages are generated in six ranges:

- 220 mV
- 2.2V
- 11V
- 22V
- 220V
- 1100V

The 11V and 22V ranges are generated by the DAC assembly, with its output, DAC OUT HI and DAC SENSE HI routed to the Switch Matrix assembly, where relays connect it to INT OUT HI and INT SENSE HI. Lines INT OUT HI and INT SENSE HI connect to the 5700A binding posts by relays on the Analog Motherboard assembly (A3).

The 2.2V range is created on the Switch Matrix assembly by resistively dividing by five the 11V range from the DAC assembly. Relays on the Switch Matrix and Analog Motherboard route the 2.2V range output to the 5700A binding posts.

The 220 mV range is an extension of the 2.2V range. The Switch Matrix assembly resistively divides by ten the 2.2V range to create the 220 mV range. Relays on the Switch Matrix and Analog Motherboard route the 220 mV range output to the front panel binding posts.

The 220V range is generated by the DAC and Power Amplifier assemblies. The the Power Amplifier amplifies the 11V range of the DAC assembly by a gain of -20 to create the 220V range. The output of the Power Amplifier is routed to the High Voltage Control assembly (A14), where a relay connects it to PA OUT DC. Line PA OUT DC is routed to the binding posts via relays on the Switch Matrix and Analog Motherboard.

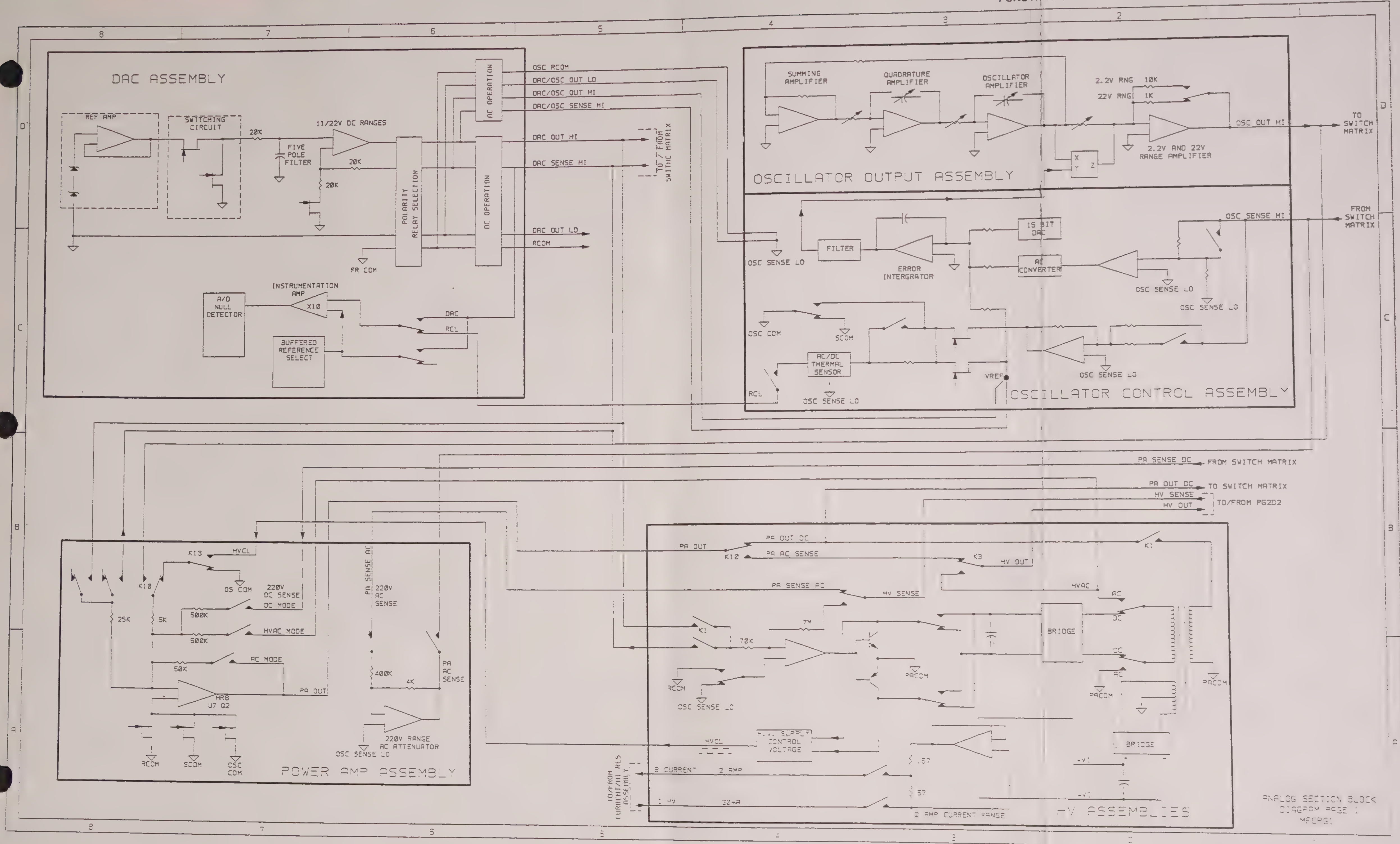


Figure 2-2. Analog Section Block Diagram, Part 1

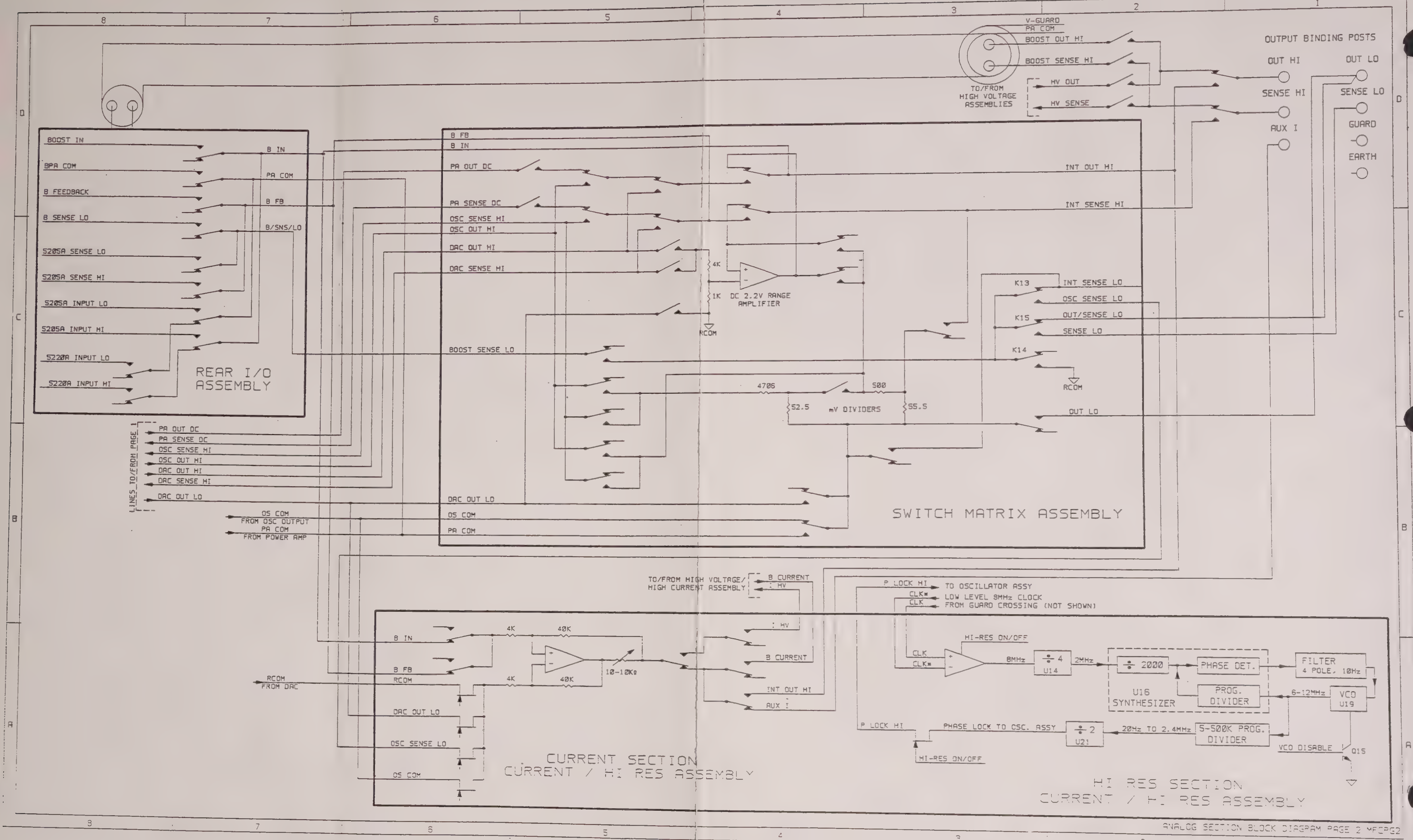


Figure 2-3. Analog Section Block Diagram, Part 2

The 1100V range is generated by the High Voltage/High Current assembly (A15) operating in conjunction with the Power Amplifier assembly and the High Voltage Control assembly. The 11V range of the DAC assembly is routed to the High Voltage/High Current assembly which amplifies by a gain of -100 to create the 1100V range. Basically the high voltage output is obtained by rectifying and filtering a high voltage ac signal generated by the High Voltage Control assembly operating in conjunction with the Power Amplifier assembly.

AC Voltage Functional Description 2-11.

The Oscillator Output assembly (A13) is the ac signal source for the 5700A. The Oscillator Control assembly (A12), controls the amplitude of this ac signal by comparing it with the accurate dc voltage from the DAC assembly and making amplitude corrections via the OSC CONT line. The frequency of oscillation is phase locked to either the high resolution oscillator on the Current/Hi-Res (A7) assembly or an external signal connected to the PHASE LOCK IN connector on the rear panel. AC voltages are generated in the following ranges:

- 2.2 mV
- 22 mV
- 220 mV
- 2.2V
- 11V
- 22V
- 220V
- 1100V

The 2.2V and 22V ranges are generated by the Oscillator Output assembly and routed to the 5700A binding posts via relays on the Switch Matrix (A8) and Analog Motherboard assemblies.

The 220 mV range is generated on the Switch Matrix assembly, which resistively divides by ten the 2.2V range of the Oscillator Output assembly. Relays on the Switch Matrix and Analog Motherboard route the 220 mV range to the 5700A binding posts.

The 2.2 mV and 22 mV ranges are generated on the Switch Matrix assembly. In this mode, the Switch Matrix resistively divides the 2.2V range or the 22V range by 1000 to create the 2.2 mV and 22 mV ranges respectively. Relays on the Switch Matrix and Analog Motherboard route these ranges to the 5700A binding posts.

The 220V range is generated on the Power Amplifier assembly. In this mode, the Power Amplifier is set for a nominal gain of -10 to amplify the 22V range from the Oscillator Output to the 220V range. The 220V ac range from the Power Amplifier is routed to the 5700A binding posts by relays on the High Voltage Control assembly and the Analog Motherboard.

The 1100V range is generated by the High Voltage Control assembly operating in conjunction with the Power Amplifier assembly. In this mode, the 22V range from the Oscillator Output is amplified by the Power Amplifier and High Voltage Control assemblies, which create an amplifier with a nominal gain of -100. Relays on the High Voltage Control and Analog Motherboard assemblies route the 1100V ac range to the 5700A binding posts.

Wideband AC V Functional Description (Option -03) 2-12.

The Wideband AC Voltage module (Option -03) consists of the Wideband Oscillator assembly (A6) and the Wideband Output assembly (A5). There are two wideband frequency ranges:

- 10 Hz to 1.1 MHz
- 1.2 MHz to 30 MHz

During operation between 10 Hz and 1.1 MHz, output from the Oscillator Output assembly is routed to the Wideband Output assembly where it is amplified and attenuated to achieve the specified amplitude range. The output is connected to the 5700A front panel WIDEBAND connector. Operation between 1.2 MHz and 30 MHz works the same way, except the input to the Wideband Output assembly is the ac signal from the Wideband Oscillator assembly.

DC Current Functional Description 2-13.

DC current is generated in five ranges:

- 20 µA - 220 µA
- 220 µA - 2.2 mA
- 2.2 mA - 22 mA
- 22 mA - 220 mA
- 2.2A

All current ranges except 2.2A are generated by the current portion of the Current/Hi-Res assembly. These currents are created by connecting the output of the DAC assembly, set to the 22V range, to the input of the Current assembly. The Current assembly uses this dc voltage to create the output current. The current output can be connected to the AUX CURRENT OUTPUT binding post by relays on the Current assembly, to the OUTPUT HI binding post by relays on the Current, Switch Matrix, and Analog Motherboard assemblies, or to the 5725A via the B-CUR line by relays on the Analog Motherboard assembly and Rear Panel assembly.

The 2.2A range is an extension of the 22 mA range. The 22 mA range output from the Current assembly is amplified by a gain of 100 by the High Voltage/High Current assembly operating in conjunction with the Power Amp assembly and the High Voltage Control assembly. The 2.2A current range is routed back to the Current assembly where it is connected to either the AUX CURRENT OUTPUT binding post, the OUTPUT HI binding post, or the 5725A in the same manner as the lower current ranges.

AC Current Functional Description 2-14.

AC current is created in the same manner as dc current, except the input to the Current assembly is the ac voltage from the Oscillator Output assembly set to the 22V range. The switching between ac and dc is carried out on the Switch Matrix, Oscillator Control, Oscillator Output, and DAC assemblies.

Ohms Functional Description 2-15.

Two assemblies function as one to supply the fixed values of resistance:

- Ohms Main assembly (A10)
- Ohms Cal assembly (A9)

All of the resistance values except the 1Ω, 1.9Ω, and short are physically located on the Ohms Main assembly. The 1Ω, 1.9Ω, and short are physically located on the Ohms Cal assembly. The desired resistance is selected by relays on these Ohms assemblies and is connected to the 5700A binding posts by relays on the Analog Motherboard. The Ohms Cal assembly also contains the appropriate circuitry to enable the 5700A to perform resistance calibration. Once calibrated, the 5700A output display shows the true value of the resistance selected, not the nominal (e.g., 10.00031 kΩ, not 10 kΩ).

Four ohms measurement modes are available. For the two-wire configuration, measurement with or without lead-drop compensation sensed at the binding posts of the UUT (using the SENSE binding posts and another set of leads), or at the ends of its test leads is available for 19 kΩ and below. Four-wire configuration is available for all but the 100 MΩ value.

SYSTEM INTERCONNECT DETAILED CIRCUIT DESCRIPTION 2-16.

The motherboard assembly contains the Digital Motherboard assembly (A4), and the Analog Motherboard assembly (A3). These two Motherboards are mechanically fastened together with screws. They are electrically connected by connectors P81 and P82 on the Digital Motherboard and connectors J81 and J82 on the Analog Motherboard. AC voltage taps from the Transformer assembly (A22) are connected to the Analog Motherboard through these connectors. Refer to Figure 2-4 for an overview of system interconnections. Figure 2-4 continues on the reverse side, showing system grounds.

Digital Motherboard Assembly (A4) 2-17.

The Digital Motherboard contains the line-select switches, line fuse, power switch, a fiber-optic transmitter (J73), and a fiber-optic receiver (J74). It also contains connectors for the Transformer assembly (A22), Digital Power Supply assembly (A19), CPU assembly (A20), Front Panel assembly (A2), Rear Panel assembly (A21), and the two 24V dc fans mounted in the chassis.

The fiber-optic receiver and transmitter provide the serial communication link between the CPU on the unguarded Digital Motherboard and the Regulator/Guard Crossing on the guarded Analog Motherboard.

Transformer Assembly (A22) 2-18.

The Transformer assembly receives ac line inputs routed through the A4 Digital Motherboard. This assembly supplies outputs throughout the 5700A, all of which are routed through the A4 Digital Motherboard.

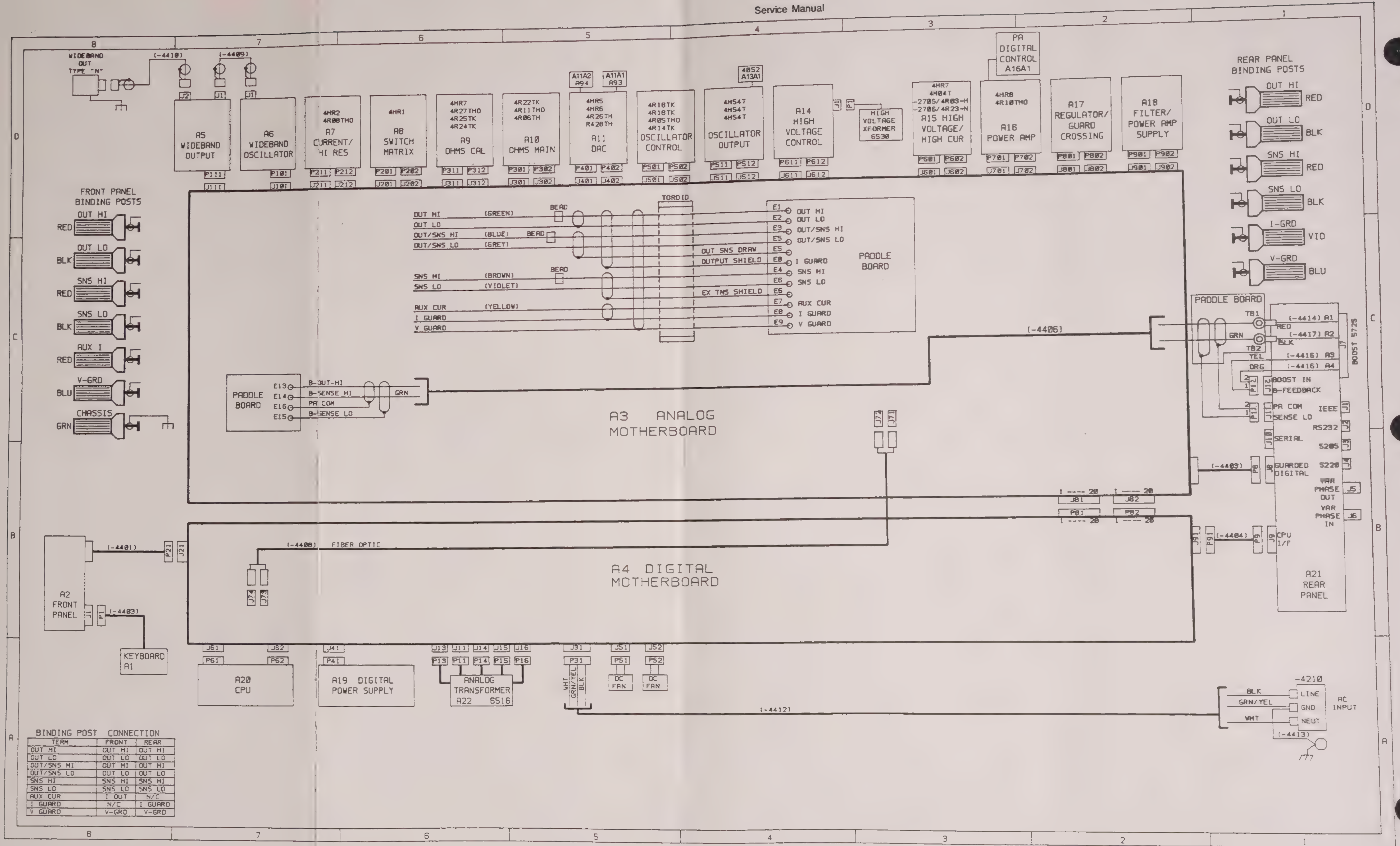
The Transformer assembly, the filter portion of the Filter/PA Supply assembly (A18), and the regulator portion of the Regulator/Guard Crossing assembly (A17) create the system power supply for all analog assemblies. The Transformer assembly also supplies ac voltages to the Digital Power Supply assembly which generates five regulated dc voltages for use by the CPU, Front Panel assembly, Rear Panel assembly, and the cooling fans.

Analog Motherboard Assembly (A3) 2-19.

The Analog Motherboard contains the connectors for all assemblies in the guarded section of the calibrator. The Analog Motherboard also contains 13 relays, a fiber-optic transmitter, a fiber-optic receiver, a cable for binding post connections, and two cables for the interface to the Rear Panel assembly. Table 2-1 lists Analog Motherboard

The fiber-optic transmitter (J72) and the fiber-optic receiver (J71) provide the serial communication link between the Regulator/Guard Crossing assembly and the CPU assembly on the unguarded Digital Motherboard.

Control lines for relays Kl-K10 and K13 on the Analog Motherboard assembly are generated on the Switch Matrix (A8) assembly. Control line RLY11*, which controls relay K11, is generated on the Current/Hi-Res assembly (A7). Control line RLY12*, which controls relay K12, is generated on the Rear Panel assembly (A21).



BINDING POST CONNECTION

TERM	FRONT	REAR
OUT HI	OUT HI	OUT HI
OUT LO	OUT LO	OUT LO
OUT/SNS HI	OUT HI	OUT HI
OUT/SNS LO	OUT LO	OUT LO
SNS HI	SNS HI	SNS HI
SNS LO	SNS LO	SNS LO
AUX CUR	I OUT	N/C
I GUARD	N/C	I GUARD
V GUARD	V-GRD	V-GRD

Figure 2-4. System Interconnections

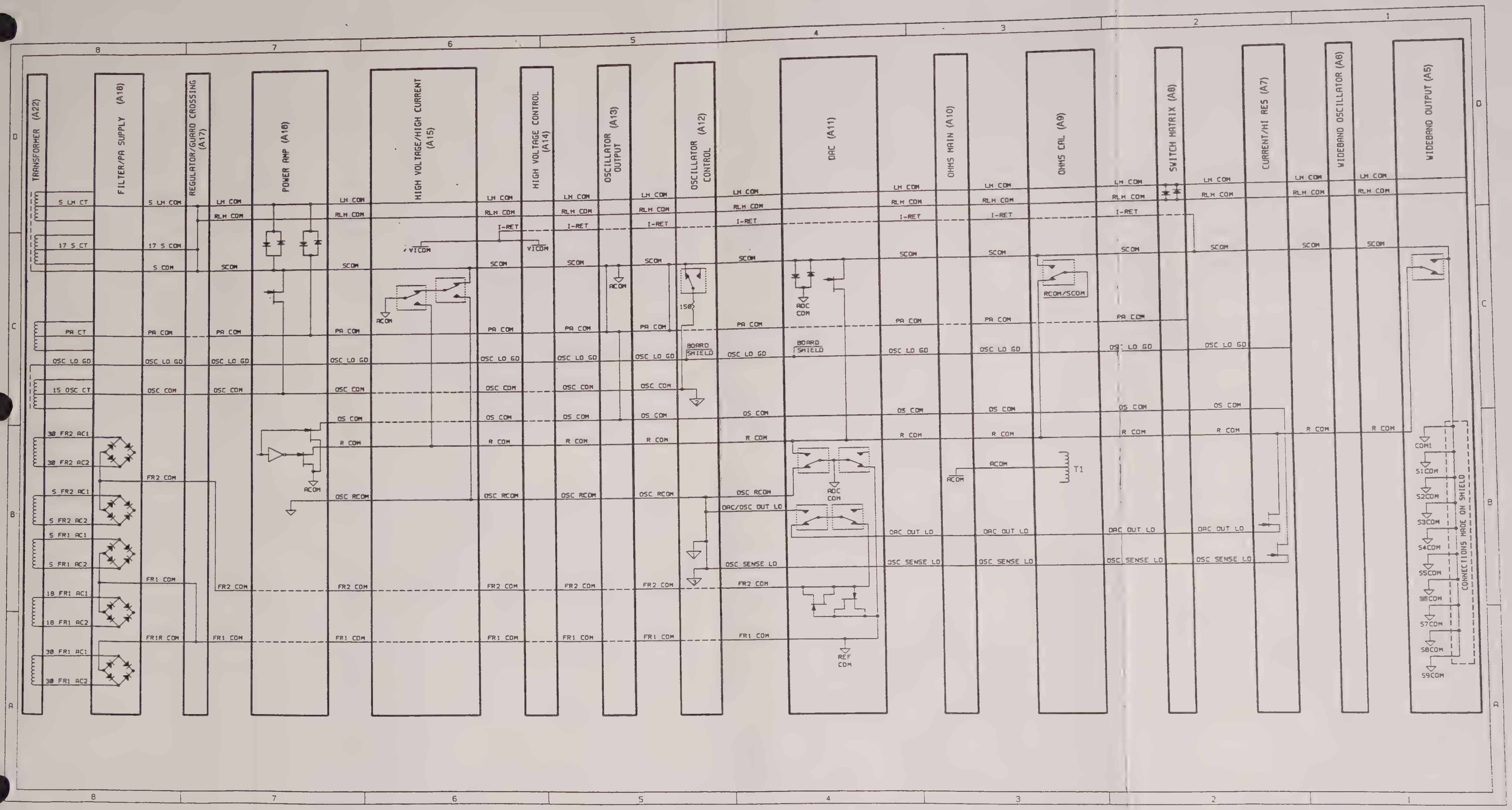


Figure 2-4. System Interconnections (cont)

Table 2-1. Analog Motherboard Connectors

MOTHERBOARD CONNECTOR	CONNECTED TO ASSEMBLY
J101	Wideband Oscillator Assembly (A6)
J111	Wideband Output Assembly (A5)
J201 and J202	Switch Matrix Assembly (A8)
J211 and J212	Current/Hi-Res Assembly (A7)
J301 and J302	Ohms Main Assembly (A10)
J311 and J312	Ohms Cal Assembly (A9)
J401 and J402	DAC Assembly (A11)
J501 and J502	Oscillator Control Assembly (A12)
J511 and J512	Oscillator Output Assembly (A13)
J601 and J602	High Voltage/High Current Assembly (A15)
J611 and J612	High Voltage Control Assembly (A14)
J701 and J702	Power Amplifier Assembly (A16)
J801 and J802	Regulator/Guard Crossing Assembly (A17)
J901 and J902	Filter/PA Supply Assembly (A18)

Line INT OUT HI is the calibrator output for ac voltage operation in the 22V range and below, dc voltage operation in the 220V range and below, all resistance functions, and all ac/dc current ranges. Relays on the Current assembly route the current output to the AUX CURRENT OUTPUT binding post via the I OUT line if so selected by the operator. INT SENSE HI is the sense high path during these modes of operation. INT OUT HI is connected to the OUTPUT HI binding post through relay K1. INT SENSE HI is connected to the SENSE HI or OUTPUT HI binding post through relays K2 and K3.

Line HV OUT is the calibrator output for dc voltage operation in the 1100V range, and ac voltage operation in the 220V and 1100V ranges. Line HV SENSE is the sense high path during these modes of operation. HV OUT is connected to the OUT HI binding post through relays K9 and K1. HV SENSE is connected to the SENSE HI or OUTPUT HI binding post through relays K10, K2, and K3.

The 5725A Amplifier output is B OUT HI and the sense high path is B SNS HI. When the 5725A is active, B OUT HI is connected to the OUT HI binding post through relays K4 and K1. When the 5725A Amplifier is inactive, B OUT HI is connected to GUARD CHASSIS by relay K12. Line B SNS HI is tied to B OUT HI through diode clamps CR1 and CR2 and is connected to the SENSE HI or OUTPUT HI binding post through relays K5, K2, and K3.

The cable from the motherboard to the binding posts consists of six insulated wires and six shields, each with its own drain wire. The OUT HI line, SENSE HI line, OUT/SENSE HI line and AUX CURRENT line each connect to an insulated wire and each has a shield around the wire. These shields are connected to OUT LO, SENSE LO, OUT/SENSE LO, and I/V GUARD, respectively. The I/V GUARD line is connected to I GUARD during operation in the current mode or V GUARD during operation in the voltage mode. This selection is done by relay K11.

When the 5700A is in standby, all binding posts are open-circuited except the GROUND binding post. In addition, GUARD CHASSIS is connected to S COM by K6. When in the operate condition, this connection is broken (K6 energized) and GUARD CHASSIS is connected to V GUARD via K7, which goes to the GUARD binding post, and to OUT LO via K8. GUARD CHASSIS is also connected to OSC LO GD by K13 except during ac or dc millivolt operation, when instead OSC LO GD is connected to S COM.

Front/Rear Binding Posts 2-20.

An internal cable can be configured to enable either the front panel or panel binding posts. When compared to front panel binding posts, the rear panel provides the same OUTPUT HI, OUTPUT LO, SENSE HI, SENSE LO, AND V GUARD functions. Also, the rear panel provides an I GUARD (current guard) connection for use when the 5700A is supplying low-level ac current through a long cable. Use of the I GUARD connection removes errors introduced by leakage through such cables. The rear panel binding posts do not provide an AUX CURRENT OUTPUT connection. The procedure to disable the front panel binding posts and enable the rear panel binding posts is to be done at Service Centers, although it is described in this manual in Section 4.

Rear Panel Assembly (A21) 2-21.

The Rear Panel assembly provides physical and electrical connections for the auxiliary amplifiers, along with RS-232-C and IEEE-488 interface connections. Relays on the Rear Panel assembly are used as the interfaces for the 5205A, 5215A, 5220A, or 5725A amplifiers, or for switching the PHASE LOCK IN and VARIABLE PHASE OUT signals.

Three Auxiliary Amplifiers can be physically connected to the Rear Panel assembly of the 5700A: the 5725A at J7, the 5220A at J4, and either 5205A or 5215A at J3. Only one amplifier can be in use at one time.

- The Rear Panel assembly provides relay switching for 5725A signals. Voltage outputs from the 5725A are routed to the binding posts on the 5700A. Current outputs are sourced at the 5725A OUTPUT binding posts. An alternate configuration is also available, allowing for routing of 5700A current outputs to the 5725A OUTPUT binding posts.
- When the 5220A (current output) is selected via the front panel, the output of the 5700A is routed to connector J4 on the rear panel, which is the interface to the 5220A.
- When the 5205A (ac and dc volts) or 5215A (ac volts only) function is selected via the calibrator keyboard, the output of the calibrator is routed to connector J3 (pins 1, 9, 2, and 10) on the Rear Panel assembly.

Filter PA Supply Assembly (A18) 2-22.

The Filter/PA Supply assembly incorporates two sections. The first section contains filters and regulators for some of the in-guard low-voltage supplies, and the second contains the power supply for the Power Amplifier output. Theory for each section is discussed separately.

DIGITAL SECTION DETAILED CIRCUIT DESCRIPTION 2-23.

Detailed descriptions of each assembly in the digital section are provided here. Simplified schematics and block diagrams are provided to supplement the text.

Digital Power Supply Assembly (A19) 2-24.

The Digital Power Supply assembly receives ac voltages from the transformer and provides five regulated dc voltages for use by the CPU, Front Panel assembly, Rear Panel assembly, and the cooling fans. All power supply voltages are referenced to COMMON, which is the transformer center tap for the ± 12V supplies. Test points at the top of the assembly can be used to check unregulated input voltages, and regulated dc output voltages. Table 2-2 lists the supplies generated by the Digital Power Supply.

+5V POWER SUPPLY 2-25.

The unregulated +5V supply uses CR25-CR28 in a full-wave rectifier configuration with filter capacitors C12, C13, and C14. Capacitors C20 and C21 filter out high-frequency noise. Inductor L8 is a common-mode choke and C11 is a bypass capacitor. The regulator is fused by 3.15A slow-blow fuse F5.

The regulated +5V is generated by three-terminal low-dropout +5V regulator U3 with heat sink. The regulator's output voltage is increased about 0.2V by CR35, a germanium diode connected between the regulator's ground pin and COMMON. Capacitor C14 is for bypass. Capacitor C23 filters out high-frequency noise. Diode CR29 protects the regulator against input shorts, and diode CR30 protects the regulator from reverse voltage. Inductor L7 and C16 further filter the output to P41.

±12V POWER SUPPLIES 2-26.

A full-wave rectifier made of diodes CR17-CR20 and filter capacitors C6 and C7 generate the unregulated +12V and -12V supplies. AC inputs are fused by F3 and F4, both 2A slow blow.

The regulated +12V supply is generated by a three-terminal +12V regulator U1 with heat sink. Capacitors C5 and C9 are for bypass. Diode CR21 protects the regulator from input shorts, and diode CR23 protects the regulator from reverse voltage. Capacitor C22 filters out high frequency noise.

Three-terminal -12V regulator U2 with heat sink generates the regulated -12V supply. Capacitors C8, C10, and C19 are for bypass. Diode CR22 protects the regulator from input shorts, and diode CR24 protects the regulator from reverse voltage.

Inductors L3-L6 filter the regulated outputs. R7 further isolates the ±12V FAN lines from the ±12V power lines. The +12V FAN and -12V FAN lines power the two 24V dc fans inside the calibrator.

+35V POWER SUPPLY 2-27.

The +35V power supply powers the grid drivers and anode drivers on the front panel output display circuitry.

Table 2-2. Supplies Generated by the Digital Power Supply

SIGNAL NAME	TEST POINT	NOMINAL OUTPUT	TOLERANCE	CURRENT LIMIT	RATED OUTPUT
+75V OUT	TP2	73V	±8%	121 mA	100 mA
+35V OUT	TP5	35V	±7%	52 mA	40 mA
+12 VOLTS	TP8	12V	±5%	1.5A	700 mA
-12 VOLTS	TP10	12V	±5%	1.5A	450 mA
+5V	TP12	5.2V	±5%	2.4A	2.0A
COMMON	TP13				

A full-wave rectifier made of diodes CR9-CR12 and filter capacitor C3 generate the unregulated +35V supply. Its input is fused by F2, a 0.125A slow-blow. Capacitor C18 is for bypass. Capacitor C25 filters out high frequency noise.

Zener diodes VR14, VR15 and transistor Q5 generate the +35V regulated output. Zener diodes VR14 and VR15 (both 18V) make up the control element which sets the output voltage. Transistor Q5 is used as an emitter follower. CR13 is the constant current source supplying current to the zener diodes and the base of Q5. Components R5 and Q6 make up the current-limiting circuit. During an over-current condition, the voltage drop across R5 turns Q6 on, thus drawing current away from the base of Q5 and limiting current flow to the output. Diode CR16 protects this circuit from reverse voltage and C4 is a bypass capacitor. Inductor L2 filters the regulated output. Resistor R13 is a bleed-off resistor for C3.

+75V POWER SUPPLY 2-28.

The +75V power supply powers the grid drivers and anode drivers on the front panel control display circuitry.

A full-wave rectifier made of diodes CR1-CR4 and filter capacitor C1 generate the unregulated +75V supply. Its input is fused by F1, a 0.315A slow-blow. Capacitor C17 is for bypass. Capacitor C24 filters out high frequency noise.

The +75V regulated output is generated by 36V zener diode VR6, 39V zener diode VR7, and transistors Q1 and Q3. Zener diodes VR6 and VR7 set the output voltage. Transistors Q1 and Q3, in a Darlington configuration for current gain, are used as an emitter follower. Transistor Q4, zener diode VR5, and resistors R2 and R3 make up the constant current source supplying current to the zener diodes and the base of Q3. Current limiting is performed by R1 and Q2 in the same manner as in the +35V supply. Diode CR8 protects the circuit from reverse voltage and C2 is a bypass capacitor. Inductor L1 filters the regulated output. Resistor R6 is a bleed-off resistor for C1.

+35V AND +75V SHUT-DOWN CIRCUIT 2-29.

The +35V and +75V high voltage supplies are shut down when a fault occurs in the control display refresh circuitry. This shut-down circuit prevents the Control Display and Output Display from burning out, and also verifies that the master clock is generating control signals for both displays.

During normal operation, 75VSD is low, turning Q10 off. Line RESETL pulls the base of Q9 high through R9, turning Q9 on. This action in turn pulls the junctions of CR31-CR32 and CR33-CR34 low, turning Q7 and Q8 off. The +75V and +35V constant-current sources can then supply the appropriate zener diodes and drive the bases of the respective emitter followers.

When a display refresh fault occurs, the 75VSD line on P41 pin 5C, coming from the Front Panel assembly, goes high. this signal, pulled up by R4, drives the base of Q10 through base resistor R11. Transistor Q10 then saturates, pulling the base of Q9 near ground, turning Q9 off. On power-up or during a CPU reset, the RESETL signal is low, pulling the base of Q9 near ground through R9, also turning Q9 off. Resistor R12 is a turn-off resistor for Q9. Diodes CR31 and CR33 are in a wired-OR configuration. When Q9 is saturated (on), CR31 and CR33 pull their respective junctions to CR32 and CR34 near ground, turning Q7 and Q8 off. When Q9 is off, the junctions are pulled high through R8 and R10, saturating Q7 and Q8 (on). When on, Q7 removes the base drive from Q3, shutting down the +75V supply. Similarly, Q8 removes the base drive from Q5, shutting down the +35V supply.

Diodes CR32 and CR34 simply ensure that Q7 and Q8 are off when Q9 is on. Resistor R8 guarantees that Q7 will hold the +75V supply off until it drops below 15.6V, and R10 holds the +35V supply off to 7.8V.

CPU (Central Processing Unit) Assembly (A20) 2-30.

The CPU (Central Processing Unit) for the 5700A is a single-board computer based on a 68HC000 microprocessor. The CPU assembly communicates with the Guarded Digital section, the Front Panel assembly, and the Rear Panel assembly. The board can be divided into three primary areas:

- The microprocessor and its support circuitry
- Memory
- Peripheral chips and I/O interfaces

Microprocessor support circuitry consists of a power-up and reset circuit, clock generation, a watchdog timer, address decoders and DTACK (data acknowledge) generator, bus error timeout, and interrupt controller.

Figure 2-5 is a block diagram of the CPU assembly. Table 2-3 is a glossary of the acronyms used in the text and schematic for the CPU assembly.

POWER-UP AND RESET CIRCUIT 2-31.

The power-up and reset circuitry consists of line monitor chip U1, C5, C6, CR1, R3, Z3, switch SW1, and inverters on U2. This circuit provides a 195 ms reset pulse at power-up or upon pressing and releasing SW1, placing the CPU assembly in a known safe condition. If the power supply glitches or falls below 4.55V ±0.05V, U1 resets the 5700A. The reset pulse duration is determined by C5. Note that SW1 performs a different function than the front panel RESET button. SW1 is a hardware reset that is hard-wired to and directly read by the microprocessor. The front panel RESET button is a software reset; it tells the system software to restore the 5700A configuration to a default condition.

The heart of this circuit is the line monitor chip U1. On power-up or when SW1 is pushed, U1 forces an active-low reset pulse on RESETL and an active-high pulse on RESET. RESETL helps to prevent accidental writes to EEPROM and drives an inverter in U2 to turn off LED CR1. CR1 indicates that the +5V supply is on and that the CPU is operating, i.e. not reset. RESETL also resets the rear panel assembly. The other output, RESET, drives two inverters in U2. One of these inverters provides HALT*. The other generates IORESET*, which drives the processor's RESET, and provides a reset for the front panel interface and DUARTs (dual universal asynchronous receiver/transmitter) circuitry.

CLOCK GENERATION 2-32.

The clock generation circuit uses components Y1, Y2, U3, U4, R4, R5, C8, C9, and E5. The crystal Y1, along with the resistors, capacitors, and an inverter in U3 generates the 7.3728 MHz primary system clock CLK. This system clock is used by the processor and is divided down by a binary counter (U4) for clocks of 3.6864 MHz, 28.8 kHz, and 450 Hz. The 450 Hz clock is used by the watchdog timer, the 28.8 kHz is used by U6 in the decoding circuit, and the 3.6864 MHz is used by the DUARTs, and the clock filter circuit. Jumper E5 allows for selection of the alternate oscillator (Y2) as the system clock.

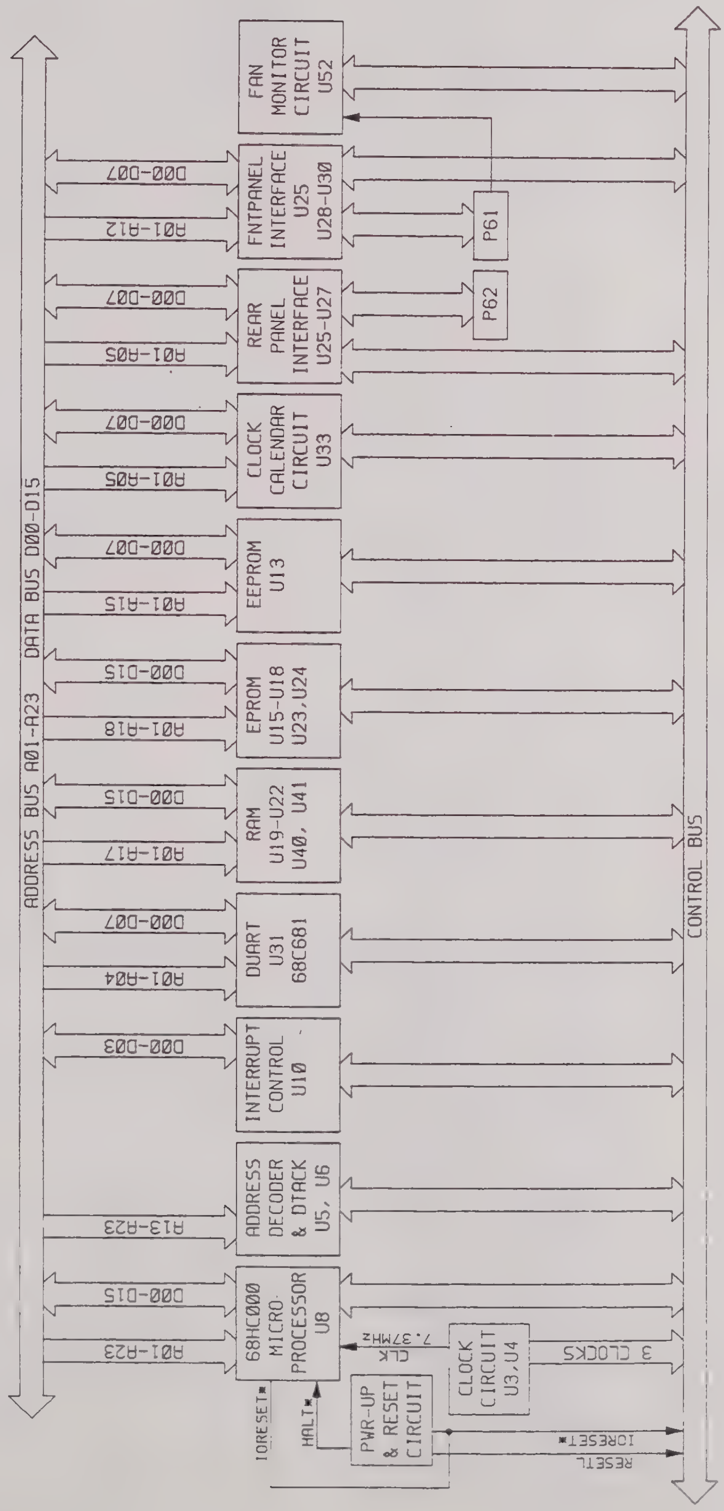


Figure 2-5. CPU Assembly Block Diagram

Table 2-3. CPU Acronym Glossary

SIGNAL NAME	FUNCTION
A01-A23	Address lines
ADCLKCS*	Clock/calendar (U33) chip select
AS*	Address strobe
BERR*	Bus error
BGACK*	Bus grant acknowledge
BR*	Bus request
BRPDRTINT*	Rear panel DUART interrupt
BRPDTK*	Rear panel data transfer acknowledge
BRPIEEEINT*	Rear panel IEEE-488 interrupt
CLKCALINT*	Clock/calendar interrupt
D00-D15	Data lines
DOGCLR	Dog clear (clears watchdog timer)
DOGINTH	Dog interrupt (interrupt from watchdog timer)
DRTDTK*	DUART data transfer acknowledge
DTACK*	Data transfer acknowledge
E	Enable for 6800 family devices (737.28 kHz clock)
EXDUARTINT*	External DUART Interru
FAN1	Signal monitoring fan 1
FAN2	Signal monitoring fan 2
FANINT*	Fan monitor interrupt
FC0	Function code output 0
FC1	Function code output 1
FC2	Function code output 2
FPDTK*	Front panel data transfer acknowledge
FRNTPNLCS*	Front panel chip select
FRNTPNLEN*	Front panel enable
GCDRTCS*	Guard crossing DUART chip select
GCDUARTINT*	Guard crossing DUART interrupt
INTRCNTL1	Interrupt control 1
INTRCNTL2	Interrupt control 2
IPL0*	Interrupt priority level 0
IPL1*	Interrupt priority level 1
IPL2*	Interrupt priority level 2
KEYBRDINT*	Keyboard interrupt
LDS*	Lower data strobe
MISCCS*	Miscellaneous chip select enable (upper address bits decoder)
NVMCS*	Nonvolatile memory chip select
NVMOE*	Nonvolatile memory output enable
PROM0CS*	PROM 0 chip select (U15 and U16)
PROM1CS*	PROM 1 chip select (U17 and U18)
PROM2CS*	PROM 2 chip select (U23 and U24)
PSFAILINT*	Power supply fail interrupt
RAM0CS*	RAM chip select (U19 and U20)
RAM1CS*	RAM chip select (U21 and U22)
RAM2CS*	RAM chip select (U40 and U41)
R/WR*	Read/write
RDINT*	Read interrupt
RDL*	Read data lower
RDU*	Read data upper
RDY/BSYL	Ready/busy
RPSEL*	Rear panel chip select
RRPNLEN*	Rear panel enable
RXDA	Receive Data Port A
RCVB	Receive Data Port B
SCLK	Serial clock
TXDA	Transmit Data Port A
TXDB	Transmit Data Port B
UDS*	Upper data strobe
WRL*	Write lower
WRU*	Write upper
XDUARTCS*	External DUART chip select

WATCHDOG TIMER 2-33.

The watchdog timer circuitry uses a 74HC4020 binary counter (U11) to divide the 450 Hz from the clock generation circuit to produce interrupt DOGINTH, signifying that the system may be locked up. This interrupt is generated 1.14 seconds after the last DOGCLR2 signal from interrupt controller U10. Therefore, DOGCLR2 must occur more often then every 1.14 seconds to clear U11 and prevent the watchdog interrupt. Generation of DOGCLR2 is under software control. The watchdog timer can be disabled by cutting jumper E1.

ADDRESS DECODING AND DTACK (DATA ACKNOWLEDGE) 2-34.

Two Programmable Logic Devices (PLDs) accomplish address decoding and DTACK (data acknowledge) generation. ICs U5 and U6 provide chip selects and generate acknowledgement signals for those devices without DTACK lines. IC U5 receives DTACK signals from the asynchronous devices and ORs these signals together to form DTACK*. Table 2-4 is the memory map for the system. It shows the chip select, address range, and notes whether AS* (address strobe) or LDS* (lower data strobe) is required.

Table 2-4. CPU Memory Map

CHIP SELECT	READ/WRITE	ADDRESS RANGE	AS* OR LDS* REQUIRED?
PROM0CS*	R	0 to 3FFFF	no
PROM1CS*	R	40000 to 7FFFF	no
PROM2CS*	R	80000 to BFFFF	no
RAM0CS*		600000 to 60FFFF	no
RAM1CS*		610000 to 61FFFF	no
RAM2CS*		620000 to 623FFF	no
NVMCS*	R/W	C00000 to CFFFFF	no
MISCCS*	R/W	D00000 to DFFFFF	no
RPSEL*	R/W	D00000 to D01FFF	LDS*
RPDUARTCS*	R/W	D00000 to D0001F	LDS*
RPIEEECS*	R/W	D00020 to D0002F	LDS*
Y52XXRD*	R	D00030 to D00031	LDS*
Y5205WR*	W	D00032 to D00033	LDS*
Y5220WR*	W	D00034 to D00035	LDS*
FRNTPNLCS*	R/W	D02000 to D03FFF	AS*
OTDCS*	R/W	D02000 to D027FF	AS*
DMDCS*	R/W	D02800 to D02FFF	AS*
ENCODERCS*	R	D03000 to D033FF	AS*
ENCODERRESET*	W	D03000 to D033FF	AS*
LED_OUTPUT_CN-	R	D03400 to D037FF	AS*
TRL	W	D03400 to D037FF	AS*
LED_LATCH_EN	R/W	D03800 to D038FF	AS*
KEYBOARDCS*	R/W	D04000 to D05FFF	LDS*
GCDRTCS*		D06000 to D07FFF	LDS*
XDUARTCS*	R/W	D08000 to D09FFF	AS*
RDINT*	W	D08000 to D09FFF	even only, AS*
DOGCLR		E00000 to EFFFFF	AS*
ADCLKCS*			

INTERRUPT CONTROLLER 2-35.

PLD U10 is the priority interrupt controller. The interrupt controller reads incoming interrupts and interrupt control lines, then encodes the highest priority interrupt into the interrupt level for the 68HC000. When the 68HC000 responds to an interrupt request, it asks the interrupt controller for an 8-bit vector that corresponds to the pending interrupt of highest priority. The interrupt controller responds with the 4 LSB's of the vector according to how it is programmed. The 4 MSB's are pulled up on resistor network Z1. Table 2-5 shows the interrupts, their priority levels, and vectors.

GLUE LOGIC 2-36.

ICs U2, U3, and U9 form the glue logic circuit, which keeps various CPU functions running properly. The four OR gates in U9 and an inverter in U3 use control signals UDS*, LDS*, and R/WR* from the microprocessor to generate control signals WRU*, WRL*, RDL*, and RDU*.

RAM (RANDOM-ACCESS MEMORY) 2-37.

Random-access memory is contained in three pairs of sockets, U19 and U20, U21 and U22, and U40 and U41. These sockets accommodate either 32K x 8 or 128K x 8 static CMOS RAM modules (32KB or 128 KB each). The 5700A is shipped with U19-U22 installed, using 32K x 8 parts and providing 128 KB of static RAM.

ROM (READ-ONLY MEMORY) 2-38.

Read-only memory is contained in three pairs of sockets, U15-U16, U17-U18, and U23-U24. These sockets accommodate 27010 EPROMS, 128K x 8 devices (128 KB each). Jumpers allow 256 KB devices to be used in their place. The 5700A is shipped with U15-U18 installed, providing 512 KB of EPROM.

ELECTRICALLY-ERASABLE PROGRAMMABLE READ-ONLY MEMORY (EEPROM) 2-39.

IC U13 is an EEPROM. The socket accommodates a 32K x 8 device (32 KB of storage.) A jumper is provided to allow an 8K x 8 (8 KB) device to be used in place of the 32 KB device. The 5700A is shipped with a 32KB EEPROM installed.

The EEPROM requires protection against inadvertent writes during power-up and power-down sequences, which could corrupt calibration constants stored there by the 68HC000. The 32 KB EEPROM provides for software-controlled protection against accidental writes.

Table 2-5. CPU Interrupts, Priorities, and Vectors

INTERRUPT	PRIORITY LEVEL	VECTOR (HEX)
NMI	7	- (not used)
DOGINTH	6	F4
BRPDRTINT*	5	F6
GCDUARTINT*	5	F7
EXDUARTINT*	5	F8
CLKCALINT*	4	F5
BRPIEEEINT*	4	F9
KEYBRDINT*	3	FA
BPSFAILINT*	2	FB
FANINT*	0	FF (not used)
RDY/BSYL	0	FF (not used)
No interrupt	0	FF

Hardware is also used to further ensure data integrity. The EEPROMs are designed so that writes to the device are prevented by holding the output enable line (NVMOE*) low. Diodes CR5, CR6 and CR8, together with resistor R6, perform a wired-OR function for three signals that control NVMOE*. Components R6, CR6 and C17 hold NVMOE* to a valid logic low for typically 37.3 ms during power-up; 26.8 ms minimum, 49.6 ms maximum. Diode CR7 provides a discharge path for C17 on power-down, allowing the operator to quickly turn the 5700A off then on again, without interfering with the power-up charge time of the capacitor. Diode CR8 allows the normal microprocessor read of the device to take place. And diode CR5 allows power monitoring IC U1 to hold NVMOE* low when the +5V power supply drops below 4.5V on power-down or during power glitches.

DUART (DUAL UNIVERSAL ASYNCHRONOUS RECEIVER/TRANSMITTER) CIRCUIT 2-40.

The 68C681 DUART (U31) has several functions. Its primary function is to provide the asynchronous serial lines that communicate with the Guarded Digital Controller over the fiber-optic path off the Digital Motherboard. A 75451 driver chip (U32) drives the fiber-optic transmitter on the digital Motherboard.

The DUART has 8 output lines that perform various functions. INTRCNTL1 and INTRCNTL2 go to the interrupt controller and are fed back to the DUART inputs. These are used by the interrupt controller to enable certain interrupts. Line SCLK is a test output of the channel A serial clock.

The DUART monitors the EEPROM ready signal and the FANINT* signal. It also has a spare serial channel that goes to connector J5. Components U44 and U43 convert the TTL-level signals at the DUART to RS-232-C-level signals at J5.

The DUART generates its own DTACK signal, DRTDTK*, which is used by U5 to generate system DTACK, DTACK*. A second DUART, U42, with associated RS-232-C drivers and receivers is used only for test purposes. It generates its own DTACK, wire-ORed to DRTDTK*.

CLOCK/CALENDAR CIRCUIT 2-41.

Time and date information is stored in a battery-backed clock/calendar circuit consisting of 32.768 kHz crystal Y3, 3V lithium battery BT1, clock/calendar IC U33, and capacitors C10 and C11. The clock/calendar IC has the necessary circuitry internally to switch operation from the power supply to battery BT1. Pull-up resistors in Z5 off U33 are to ensure low power operation when the +5V supply is off. U33 generates CLKCALINT* under software control.

CLOCK FILTER CIRCUIT 2-42.

The clock filter circuit generates a 3.6864 MHz 200 mV sine wave for the Rear Panel and Front Panel assemblies. This circuit buffers the 3.6864 MHz Clock with an inverter in U3. The circuit contains dc-blocking capacitor C80, two stages of a low pass LC filter (L80 and C81, L81 and C82), transformer T51, and termination resistor R82.

CPU TO REAR PANEL INTERFACE 2-43.

Components U25, U26, U27, and connector P62 interface the CPU to the rear panel. Bi-directional bus transceiver U26 buffers the data lines. Signal R/WR* controls the transmission direction of the data lines, and RRPNLEN* is the chip enable. IC U25 buffers control lines BRPDRTINT*, BRPIEEEINT*, and BRPDTK*. U27, enabled by RRPNLEN*, buffers address line A01-A05 and control lines WRL* and R/WR*. Control lines RESETL, RPSEL*, TXDB, RCVB, and XMT go directly to connector P62.

CPU TO FRONT PANEL INTERFACE 2-44.

Components U25, U28, U29, U30 and connector P61 interface the front panel to the CPU. Bi-directional bus transceiver U30 buffers the data lines. Control signal R/WR* controls the transmission direction of the data lines, and FRNTPNLEN* is the chip enable. IC U28, enabled by FRNTPNLEN*, buffers address lines A05-A12. IC U29, also enabled by FRNTPNLEN*, buffers address lines A01-A04 and control line R/WR*. Two sections of U25 in parallel buffer IORESET*, providing twice the drive current of a single section, generating BRESET*. Three other sections of U25 buffer FPINT*, FPDTK*, and PSFAILINT*. Control line FRNTPNLCS* goes directly to connector P61.

FAN MONITOR 2-45.

The fan monitor circuit detects whether one of the two fans is fully or partially shorted, open-circuited, or drawing excessive current. Current-sense resistors on the Digital Motherboard send analog signals FAN1 and FAN2 to the CPU through P61. FAN1 is subtracted from FAN2 in U52D, and the difference is amplified before being sent to a window comparator made up of U52B and U52C (plus associated resistors). Capacitors C12 and C13 act as low-pass filters for the two signals, preventing spurious noise from interfering with detection circuitry.

When the output of U52D is greater than +5V, the output of U52B goes low (to about -11V); otherwise the output is high (about +11V). U52A takes the +5V and generates a -5V reference for comparator U52C. When the output of U52D is more negative than -5V, the output of U52C goes low (to about -11V); otherwise the output is high (about +11V). The outputs of U52B and U52C are wire-ORed through CR2 and CR3, using R52 and R53 to limit current sunk by the comparators when their respective outputs are low. Schottky barrier diode CR4 converts the -11V outputs of the comparators, when either is low, to a TTL-level logic low, which is the active (true) level of FANINT*.

When both fans are functioning properly, diodes CR2 and CR3 are reverse-biased, effectively taking the comparators out of the circuit. At this point, R51 pulls FANINT* to a valid TTL-level logic high, the inactive state of FANINT*. R51 and CR4 level-shift the ±11V signal to valid TTL levels.

Signal FANINT* goes to DUART U31 and to the interrupt controller U10 for further processing. System software monitors FANINT* through U31, and can program the DUART to generate a GCDUARTINT* interrupt signal on FANINT* going low.

Front Panel Assembly (A2) 2-46.

The Front Panel assembly, operating in conjunction with the Keyboard assembly (linked by a cable), is the operator interface to the 5700A. This assembly contains two separate vacuum-fluorescent displays: the Control Display and the Output Display. Each display has its own control, high voltage drive, and filament-switching circuits. This assembly also contains clock regeneration, refresh failure detect, keyboard scanner, rotary knob encoder, LED drive, and decoding and timing circuitry.

Connector J2 connects this assembly with the Keyboard/Encoder. Connector J1 interfaces with the CPU assembly and the Digital Power Supply assembly via the Digital Motherboard.

CLOCK REGENERATION CIRCUITRY 2-47.

To minimize EMI (electro-magnetic interference), the Front Panel assembly accepts a low-level sine-wave (approximately 200 mV p-p) 3.6864 MHz clock from the CPU assembly and converts it to a TTL-acceptable level. This is done by high-speed differential comparator (U7A), operating on incoming signals 3.6864MHZCLK and 3.6864MHZCLK*. The output of U7A is the input to U8 and is also inverted by U11B to create the 3.6864 MHz clock signal CLOCK. Twelve-stage binary counter U8 divides the 3.6864 MHz clock by eight and U11A inverts the signal to create 460.8 kHz. The master clock is further divided by U8, which outputs a 900 Hz signal on pin 1. These clocks provide system timing for the other ICs on the assembly. A -5.2V supply for U7 is provided by VR5, with C64 acting as the supply bypass.

REFRESH FAILURE DETECT CIRCUITRY 2-48.

If a clock failure were to occur, the refresh cycles of the vacuum-fluorescent displays would be interrupted. This condition could damage the tubes if not immediately detected. Refresh failure detect circuitry monitors the GRIDDATA output from the last high voltage driver (U23) for the Control Display. This output (REFRESH) is used to clear a watchdog timer (U6) every refresh cycle. If the refresh is interrupted and GRIDDATA does not occur, the watchdog timer times out and latches U12. Flip-flop U12 generates control lines 75VSD and PSFAILINTR*. Control line 75VSD is routed to the Digital Power Supply assembly to shut down the +35V and +75V power supplies, thus preventing damage to the vacuum-fluorescent displays. Interrupt line PSFAILINTR* is used by PLD U3 to properly blank the Control Display and Output Display through DMDBLANK and OTDBLANK, and alerts the CPU that this failure has occurred.

DECODING AND TIMING CIRCUITRY 2-49.

Main decoding and master timing functions for the front panel are accomplished by an EP900 PLD (Programmable Logic Device), U3. Two state machines control display refresh and filament switching. Filament switching is handled by two non-overlapping 57.6 kHz signals.

Signals GSTRBE and STROBE are master timing and synchronization signals used by the other ICs. Signal DMDBLANK controls the Control Display grid drivers, ABCLK and CDCLK control the Control Display anode drivers, and OTDBLANK controls the Output Display grid and anode drivers. Front panel DTACK and interrupt functions, and generation of the various chip select and reset signals are also provided by U3. Table 2-6 is a memory map for the front panel.

Table 2-6. Front Panel Memory Map

NAME	READ/WRITE	ADDRESS
OTDCS*	R/W	D02000 to D027FF
DMDCS*	R/W	D02800 to D02FFF
ENCODERCS*	R	D03000 to D033FF
ENCODERRESET*	W	D03000 to D033FF
LED_OUTPUT_CNTRL	R	D03400 to D037FF
LED_LATCH_EN	W	D03400 to D037FF
KEYBOARDCS*	R/W	D03800 to D03BFF

CONTROL DISPLAY CIRCUITRY 2-50.

Control display circuitry consists of a 26-row by 256-column vacuum-fluorescent dot matrix display under the control of PLD U4, four high voltage grid drivers (U20-U23), four high voltage anode drivers (U16-U19), a filament switching circuit, and 1K x 8 (1 KB) dual-port RAM U1.

This display is divided into 129 grids; alternate grids contain two anode columns lettered B C or D A. Grid G129 and column C in grid G128 are not used. Each column contains 26 individual anodes.

IC U4 is an EP900 Programmable Logic Device (PLD). It provides the timing and control signals for control display circuitry. Display data written by the microprocessor into the Control Display's dual port RAM (U1) is read by U4 and sent serially to the high voltage anode drivers. Both the anode and grid drivers are serial TTL-level input, 32-bit parallel high voltage output devices. IC U4 also controls the grid timing and display refresh.

```
**************        *************        *************
*            *        *           *        *           *
*   B    C   *        *   D   A   *        *   B   C   *
*            *        *           *        *           *
*      G4    *        *    G5     *        *    G6     *
*            *        *           *        *           *
**************        *************        *************
```

Adjacent columns in adjacent grids are driven, while the opposite columns are turned off. For instance, grid G4 contains columns B and C, and grid G5 contains columns D and A. G4 and G5 are driven simultaneously while anode columns G4-C and G5-D are activated, and G4-B and G5-A are driven off. Next, grids G5 and G6 are driven simultaneously, while columns G5-A and G6-B are activated, and G5-D and G6-C are driven off. This pattern is repeated for all 128 grids at a refresh rate of about 75 Hz.

This particular scheme was selected because of the way the anode drivers are loaded with display data. Both the A and C (U16 and U18), and B and D (U17 and U19) anode drivers' input registers are latched with the same data, while the output drivers are appropriately enabled and displaying the data previously strobed to the driver outputs from the input registers. The input register data is strobed to the output drivers while all of the drivers are disabled, or blanked. Following this, either the A and B drivers are enabled to display the A-B data, when the C and D drivers, latched with A-B data, are disabled, or the C and D drivers are enabled to display the C-D data, when the A and B drivers, latched with C-D data, are disabled.

Control display filament driver circuitry consists of transistors Q1 through Q6 and zener diodes VR1 and VR2, with associated resistors. The transistors are driven by 7406 open collector drivers U13B and U13A. These drivers are controlled by AOUT and BOUT. AOUT and BOUT are synchronous, non-overlapping, three-eighths duty cycle, 57.6 kHz timing signals generated by U3. Each signal is alternately active high for 6.51 μs, with a dead time between active signals of about 2.17 μs to allow for turn-off times of the drive transistors. When AOUT is high, U13B turns Q2 and Q4 on. Q4 turns Q6 on, providing a path for the filament current through Q2 and Q6. Zener diode VR2 provides the dc voltage offset necessary for proper filament operation. Then when BOUT is high, U13A turns Q1 and Q3 on. Q1 turns Q5 on, providing a path for the filament current through Q3 and Q5, effectively reversing the direction of the voltage driving the filament. Zener diode VR1 provides the dc voltage offset necessary for proper filament operation.

PLD U4 also generates the 225 Hz square-wave SCAN signal used by PLD U9 to control front panel keypad scanning and key debounce.

Dual-port RAM U1 contains all the Control Display data written by the 68HC000 microprocessor on the CPU board. PLD U4 contains a 10-bit address counter which is used by U4 to read the contents of U1. U1 provides a BUSYD signal to U3, which is active low whenever the CPU and U4 try to access the same RAM location at the same time. If the microprocessor attempts to write to the RAM location that U4 is reading (as it refreshes the DMD), U3 uses BUSYD to hold off DTACK to the microprocessor. This prevents the written data from being lost. The other busy signal, generated when U4 attempts to read from a location being written to by the microprocessor, is ignored. Losing display data for one refresh cycle is insignificant.

OUTPUT DISPLAY CIRCUITRY 2-51.

Output display circuitry consists of a custom 2-row, 22-character vacuum-fluorescent display under the control of PLD U5. The circuit contains high voltage grid driver U15, high voltage anode driver U14, a filament switching circuit, and a 1K x 8 (1 KB) dual-port RAM, U2.

The custom display is divided into 24 grids. The 22 characters are made up of fourteen seven-segment digits and eight 14-segment characters.

IC U5 is an EP900 PLD, programmed to provide the timing and control signals for the output display circuitry. Display data written by the microprocessor into the Output Display's dual-port RAM U2, is read by U5 and sent serially to the high voltage anode driver. Both the anode and grid drivers are serial TTL-level input, 32-bit parallel high voltage output devices. Only 31 anode driver outputs and 24 grid driver outputs are used, the remaining high voltage outputs are left unconnected. IC U5 also controls grid timing and display refresh.

A special refresh scheme is used by the Output Display to intensify a specific digit to be displayed. This feature is used by the 5700A when in Error Mode, while editing a value displayed on the Output Display. The digit selected for editing is brighter than the other digits. To accomplish this, U5 monitors data it reads from the dual-port RAM. Following the entry of the fourth data byte to the input registers of the anode driver, the registers are strobed to the high voltage output drivers, then the drivers are enabled. If data bit D7 of the fourth byte is low, the state machine in U5 simply goes on to refresh the next digit at the normal rate of approximately 200 Hz. If, however, bit D7 of the fourth byte is high, the state machine enters a delay routine that adds about 625 µs to the normal 5 ms anode and grid on-time, thereby intensifying the digit. Unlike the Control Display, only one grid at a time is turned on.

Output display filament driver circuitry consists of transistors Q7-Q12 and zener diodes VR3 and VR4, plus associated resistors. The transistors are driven by 7406 open-collector drivers U13C and U13D. These drivers are controlled by AOUT and BOUT as in the Control Display. When AOUT is high, U13C turns Q8 and Q10 on. Q10 turns Q12 on, providing a path for the filament current through Q8 and Q12. Zener diode VR4 provides the dc voltage offset necessary for proper filament operation. Then when BOUT is high, U13D turns Q7 and Q9 on. Q7 turns Q11 on, providing a path for the filament current through Q9 and Q11, effectively reversing the direction of the voltage driving the filament. Zener diode VR3 provides the dc voltage offset necessary for proper filament operation.

Dual-port RAM U2 contains all the Output Display data written by the 68HC000 microprocessor on the CPU board. U5 contains a 7-bit address counter which U5 uses to read the contents of U2. U2 provides a BUSYO signal to U3, which is active low whenever the CPU and U5 try to access the same RAM location at the same time. If the microprocessor attempts to write to the same RAM location U5 is reading as it refreshes the Control Display, U3 uses BUSYO to hold off DTACK to the microprocessor. This prevents written data from being lost. The other busy signal, generated when U5 attempts to read from a location being written to by the microprocessor, is ignored. Losing display data for one refresh cycle is insignificant.

IC U5 also generates the FPINTR* (front panel interrupt, active low) signal sent to the 68HC000 microprocessor, telling it there is an encoder or keyboard interrupt. The interrupt inputs to U5, ENCODERINTR (encoder interrupt, active high) and KEYBOARDINTR (keyboard interrupt, active high), are generated by PLDs U24 and U9 respectively.

KEYBOARD SCANNER CIRCUITRY 2-52.

The key matrix is scanned by PLD U9. It sequentially drives one of the eight columns for about 2.2 ms, then reads all six rows of the matrix on each column scan. When a key is pressed and the column associated with that key is scanned, the row associated with that key goes low. If the key is still pressed after a 6.6 ms debounce period, U9 generates signal KEYBOARDINTR. This signal goes to U5 where it generates FPINTR*, which interrupts the 68HC000 microprocessor. The microprocessor generates KEYBOARDCS* through PLD U3, causing U9 to output encoded row and column data on the data bus for the microprocessor to read. This also resets the keyboard interrupt.

The microprocessor controls the speaker, also referred to as the beeper. Writing a logic high on data line D6 to U9 enables the speaker, writing a logic low on D6 disables the speaker. When enabled, a 900 Hz square-wave signal generated by U8 is gated out to the speaker through U9.

KNOB ENCODER CIRCUITRY 2-53.

Knob encoder circuitry consists of PLD U24 and resistors R22, R23, R26, and R27. The resistors configure the U24 knob inputs as Schmitt trigger inputs, with approximately 400 mV of hysteresis. The Schmitt inputs receive the two quadrature signals from the optical shaft encoders at the knob, and remove digital bounce that can result from slowly rotating the knob. The state machine inside U24 uses these signals to determine direction and amount of rotation.

A feature was incorporated to allow the operator to quickly spin the knob and allow the 5700A to properly track it in spite of the inherent delay servicing the interrupt. Every time the operator moves the knob through a 180° rotation of a single detent, U24 generates ENCODERINTR which is sent to U5. IC U5 then generates FPINTR*, interrupting the 68HC000 microprocessor. The microprocessor services the encoder interrupt by reading U24. On a read, indicated by a logic low on ENCODERCS*, U24 places the contents of a seven-bit up/down counter on the data bus. The counter keeps track of the number of 180° rotations that have occurred between the time the interrupt was first initiated and the counter is read. The counter is incremented or decremented depending on the direction of rotation. Signal ENCODERRESET*, generated by U3 on a write to the front panel encoder address space, clears the encoder interrupt.

LED CIRCUITRY 2-54.

The LED circuit controls the four light-emitting diodes mounted on the keyboard assembly. It includes a 74LS373 8-bit latch (U10), and four resistors (R16-R19). The respective LEDs light when the following states are active: external sense (EX SNS), external guard (EX GRD), the wideband module is active (WBND), or when an attached 5725A Amplifier is active (BOOST).

Latch (U10) is controlled by the LED_LATCH_EN signal from the decoding PLD U3. Signal LED_LATCH_EN latches the CPU data bus into the internal latches of U10 on a write to the front panel LED memory space. This data appears at the output when control line LEDENABLE* goes low. Control line LED_OUTPUT_CNTRL from U3 is inverted by U11C to create LEDENABLE*. Table 2-7 shows which line activates each LED.

Keyboard Assembly (A1) 2-55.

The Keyboard assembly provides the operator with front panel control of the 5700A Calibrator. It connects to the Front Panel assembly (A2) through a cable, and includes an elastomeric keypad, four LEDs, and a rotary encoder (output adjustment) knob.

The elastomeric keypad and the printed circuit board form a 45-switch keyboard arranged in eight columns and six rows. The keyboard scanner circuit on the Front Panel assembly sequentially drives columns one through eight. When a key is pressed, a low appears on the corresponding row as the key's column is scanned. The keyboard scanner circuit encodes the key's row and column location, then takes appropriate action.

The four LEDs (CR1-CR4) are controlled by the LED driver circuit on the Front Panel assembly. LED CR1 is turned on by LED1A when external sensing is selected. LED CR2 is turned on by LED2A when external guard is selected. LED CR3 is turned on by LED2B when the wideband module is active. LED CR4 is turned on by LED1B when an attached 5725A Amplifier is active.

The rotary output adjustment knob activates UUT "Error Mode", allowing the operator to adjust the 5700A output. It can also control the phase shift for variable phase output. The knob assembly consists of two optocouplers (DT1 and DT2) and a magnetically-detented rotary knob. As the knob is turned, optocoupler DT1 generates a pulse signal on ENCODERA and optocoupler DT2 generates a pulse signal on ENCODERB. These signals are routed to the Front Panel assembly where knob encoder circuitry interprets these signals and takes appropriate action. The current-limiting resistor for LEDs within DT1 and DT2 is located on the Front Panel assembly.

ANALOG SECTION DETAILED CIRCUIT DESCRIPTION 2-56.

Detailed descriptions of each assembly in the analog section are provided here. Simplified schematics are provided to supplement the text.

Table 2-7. Control Lines for the Keyboard LEDs

KEYBOARD LED	CONTROL LINES
EX SNS	LED1A
EX GRD	LED2A
W BND	LED2B
BOOST	LED1B

Filter/PA Supply (A18), Low-Voltage Filter/Regulator Section 2-57.

The Filter assembly receives various ac inputs from the main power transformer and provides unregulated dc to the Regulator/Guard Crossing assembly (A17), and regulated dc supplies +5FR1, -18FR1, and -5FR2 to the DAC assembly. The unregulated supplies are listed in Table 2-8 and the regulated supplies are listed in Table 2-9.

UNREGULATED OSC SUPPLIES 2-58.

Line OSC COM is the return path for the +15 OSCR and -15 OSCR supplies. These supplies use a full-wave center-tapped configuration. They consist of bridge rectifier CR3 and two filter capacitors, C4 and C6, for +15 OSCR and -15 OSCR, respectively. Inputs are fused with 1.6A slow-blow fuses F1 and F2.

Table 2-8. Unregulated Supplies from the Filter Assembly

SIGNAL NAME	NOMINAL OUTPUT	TOLERANCE	MAX. P-P RIPPLE	RATED OUTPUT	TEST POINT
+15 OSCR	27V	±8V	2V	200 mA	TP2
-15 OSCR	27V	±8V	2V	200 mA	TP5
OSC COM	RETURN				TP4
+5 LHR	12V	±4V	3V	3.5A	TP1
-5 LHR	12V	±4V	2V	400 mA	TP6
LH COM	RETURN				TP3
+44 SR	60V	±15V	3V	155 mA	TP7
-44 SR	60V	±15V	3V	460 mA	TP9
44 S COM*					TP22
+17 SR	27V	±8V	3V	1.3A	TP10
-17 SR	27V	±8V	3V	1.3A	TP14
17 S COM*	RETURN				TP12
+5 FR1R	12V	±4V	2V	400 mA	TP17
-18 FR1R	27V	±8V	2V	50 mA	TP20
FR1 COM	RETURN				TP19
+30 FR1R	50V	±15V	3V	85 mA	TP15
FR1R COM	RETURN				TP16
+30 FR2R	RETURN	±15V	3V	85 mA	TP8
FR2 COM					TP11

* 44 S COM and 17 S COM are tied together on the Regulator/Guard Crossing assembly (A17).

Table 2-9. Regulated Supplies from the Filter/PA Supply

SIGNAL NAME	NOMINAL OUTPUT	TOLERANCE	CURRENT LIMIT	RATED OUTPUT	TEST POINT
-5 FR2	-5V	±0.3V	0.15A	0.03A	TP13
FR2 COM	RETURN				TP11
+5 FR1	+5V	±0.3V	2A	0.1A	TP18
-18 FR1	-18V	±0.9V	2A	0.05A	TP21
FR1 COM	RETURN				TP19

UNREGULATED LH SUPPLIES 2-59.

Line 5 LH COM is the return path for the +5 LHR and -5 LHR supplies. These supplies use a full-wave center-tapped configuration, and consist of four diodes (CR1, CR2, CR4, CR5) configured as a bridge rectifier.

Capacitors C2 and C3 filter +5 LHR, and C5 filters -5 LHR. Capacitor C1 reduces the level of generated transients.

UNREGULATED S SUPPLIES 2-60.

The ±44 SR supplies use full-wave center-tapped rectifiers. Bridge rectifier CR6 is followed by two filter capacitors C7 and C8 for the +44 SR and -44 SR supplies, respectively. Inputs are fused by 0.5A slow blow fuses, F3 and F5. The ±17 SR supplies also are full-wave center-tapped, consisting of four diodes (CR8, CR10, CR12, CR13) configured as a bridge rectifier. Capacitors C13 and C14 filter the +17 SR supply, while C15 and C16 filter the -17 SR supply.

TRIAC CIRCUIT 2-61.

The triac circuit protects the 5700A if it is inadvertently plugged into an excessively high line voltage. For example, it protects the 5700A if it is plugged into a 230V line when the rear panel line voltage select switches are set for 115V operation.

This circuit contains triac CR19, zener diodes VR20, VR21, resistor R1, and capacitor C23. The zener diodes set a trip voltage of 82V. If the ac voltage across the main transformer secondary for the ±17V supply exceeds 82V, the triac fires, shorting out the winding, which causes the main transformer primary fuse to blow.

FR1 SUPPLIES 2-62.

Line FR1 COM is the return path for the unregulated +5 FR1R raw supply and the regulated +5 FR1, and -18 FR1 supplies. Each supply uses a full-wave bridge configuration.

The unregulated +5 FR1R supply consists of bridge rectifier CR15 and filter capacitor C19. The input is fused with 1.6A slow-blow fuse F8. The regulated +5 FR1 supply uses the unregulated +5 FR1R supply and contains regulator U2, filter capacitor C20, and protection diode CR16.

The -18 FR1 supply consists of bridge rectifier CR17 and filter capacitor C21. Its input is fused with 0.5A slow-blow fuse F9. The regulated -18 FR1 supply uses the unregulated -18 FR1 supply and contains regulator U3, filter capacitor C22, and protection diode CR18.

UNREGULATED FR1 SUPPLY 2-63.

FR1R COM is the return path for the unregulated +30 FR1 supply. This supply uses full-wave bridge rectifier CR14 and filter capacitor C18. Its input is fused with 0.5A slow-blow fuse F7.

FR2 SUPPLIES 2-64.

FR2 COM is the return path for unregulated +30 FR2R supply and regulated -5 FR2 supply. Each supply uses a full-wave, bridge configuration. The unregulated +30 FR2R supply consists of bridge rectifier CR7 and filter capacitor C9. Its input is fused with 0.5A slow-blow fuse F4. The -5 FR2 supply consists of bridge rectifier CR11, filter capacitor C11, regulator U1, bypass capacitor C12, and protection diode CR9. The input is fused with 315 mA slow-blow fuse F6.

Filter/PA Supply (A18), Power Amplifier Output Supply Section 2-65.

The power amplifier output power supply section of the Filter/PA Supply assembly (A18) receives ac voltage from the main power transformer to generate power supplies +PA and -PA for the output stage of the Power Amplifier assembly (A16). These two power supplies can be switched between the following three modes of operation, depending on the needs of the Power Amplifier.

- +PA and -PA to ±185V respectively.
- +PA and -PA to ±365V respectively.
- +PA and -PA are both turned off.

Figure 2-6 is a simplified schematic for the Power Amplifier Output Supply section of this assembly.

±PA SUPPLIES DIGITAL CONTROL 2-66.

Circuitry to control the three modes of operation of the +PA and -PA supplies is located on the Power Amplifier Digital Control SIP assembly (A16A1). This SIP assembly is mounted on the main Power Amplifier assembly (A16). Not on the assembly is the quad comparator U201.

The main Power Amplifier assembly generates four control lines:

- +HI/LO V
- LO/HI I
- +ON/OFF
- H/LV S

Component Z201 pulls these signals up. At calibrator power up, the ±PA supply is off. The Power Amplifier Digital Control SIP (A16A1) selectively pulls these control lines low to achieve the two modes of operation. Pulling control lines +HI/LO V and +ON/OFF low sets the +PA supply to +365V. Releasing +HI/LO V changes the +PA supply to 185V.

The comparator (U201) provides level shifting to control the PMOSFETS in the -PA circuit in a similar way. Signal -ON/OFF is generated from +ON/OFF, and -HI/LO V from -H/LV. Control line +LO/HI I switches transistor Q217 which controls relay K201. Relay K201 selects the current limit for both +PA and -PA supplies.

±250V AND ±500V SUPPLIES 2-67.

Input signals PA CT, PA HAC1, PA HAC2, PA LAC1, and PA LAC2 come from the main transformer.

- PA CT is the center tap.
- PA HAC1 and PA HAC2 are high voltage taps with approximately 400V rms and are fused by F201 and F204 respectively.
- PA LAC1 and PA LAC2 are lower voltage taps with approximately 200V rms and are fused by F202 and F203 respectively.
- PA LAC1 and PA LAC2 and bridge rectifier CR222 generate the unregulated ±250V supplies.
- PA HAC1 and PA HAC2 and diodes CR217, CR218, CR220, CR221, CR223, CR224, CR227, and CR228 are in a bridge rectifier configuration to generate the unregulated ±500V supplies.

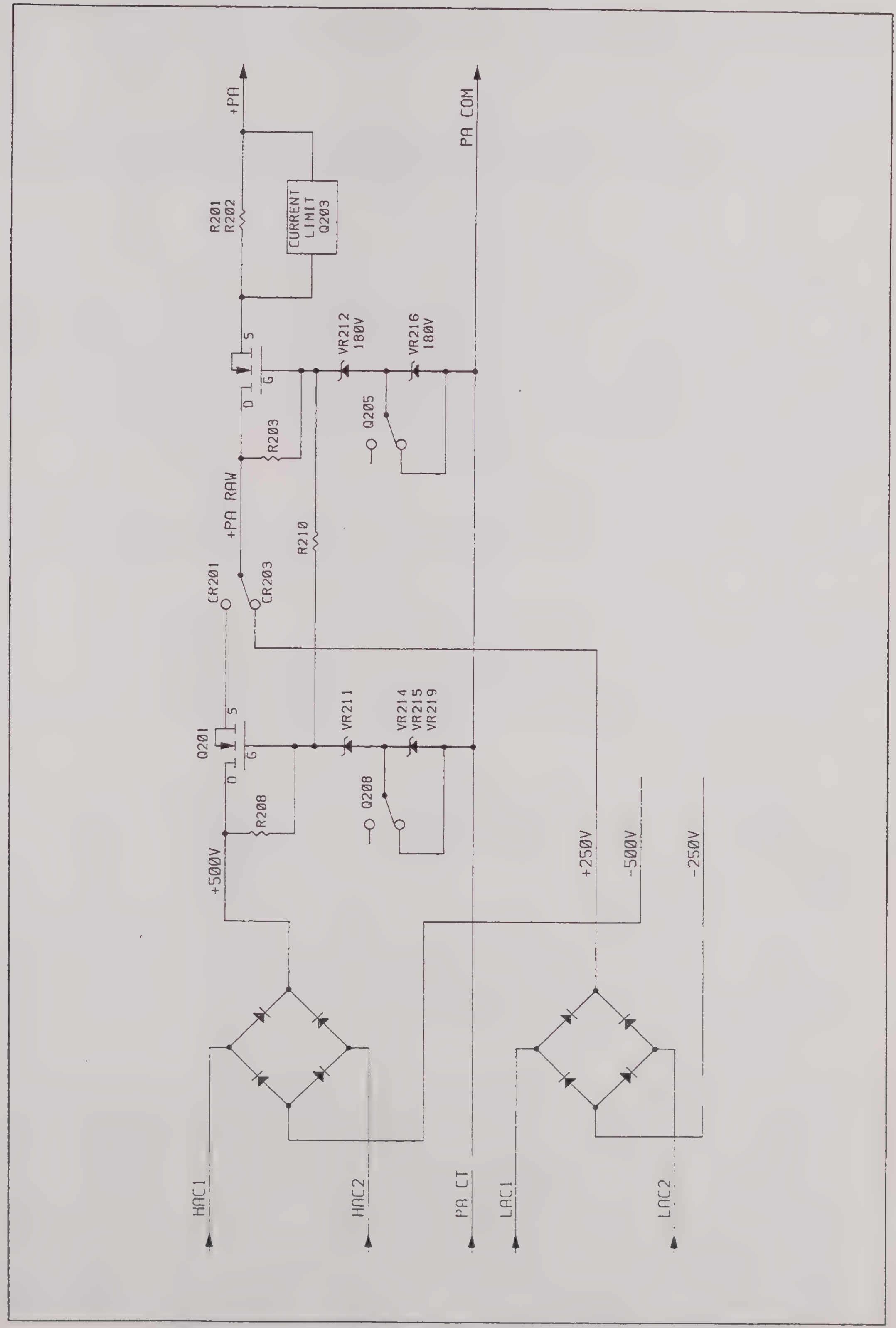


Figure 2-6. Power Amplifier Output Supply Simplified Schematic

When the PA supply outputs ±185V, current is drawn only from the lower voltage taps LAC1 and LAC2.

+PA AND -PA SUPPLIES 2-68.

Unregulated voltage for +PA is selected between the +250V and +500V unregulated supplies by control line +HI/LO V and diodes CR201, CR203, CR208, and CR210.

Transistor Q204 is a current source that biases VR212 and VR216.

Supply +PA is +185V when the +HI/LO V signal is above 3V. (Transistors Q205 and Q208 are turned on.) Transistor Q205 shorts VR216, while Q208 places a short across VR214, VR215, and VR219. A voltage of +185V appears at the gate of Q202 because of VR212. Approximately 140V appears at the gate of Q201. This 140V and about 250V at the anode of CR208 reverse biases CR201 and CR210, thereby shutting off Q201. Current flows out of the 250V unregulated supply through CR203 and Q202. Regulated supply voltage +PA is determined by the gate voltage of Q202, which is about 190V when +HI/LO V is above 3V.

When +HI/LO V is close to 0V, both Q208 and Q205 are turned off, and over 400V appears at the gate of Q201. CR203 and CR208 are reverse biased, and the supply current flows from the +500V unregulated supply through Q201, CR201, and Q202. The gate voltage of Q202 is approximately 370V, nearly the same as +PA.

The -PA side works exactly like the +PA side except -PA is switched between -185V and -365V by control line -HI/LO V.

The ±PA supplies can be replaced by the ±44SR unregulated supplies by moving switch S201 switched towards the top edge of the board. This feature provides the means to troubleshoot the Power Amplifier using reduced voltages.

NOTE

Make sure S201 is returned to the ±PA position before resuming normal operation.

±PA SUPPLY CURRENT LIMIT 2-69.

The current limit for both the +PA and -PA supplies is set to either about 90 mA (K201 de-energized) or 150 mA (K201 energized) by K201. Control line +LO/HI I controls relay K201. The high-current mode (150 mA) is used during operation in the 1100V dc range and the 2.2A range.

Output current on the +PA side is sensed between the emitter and base of Q203 by R202 and/or R201. Supply +PA shuts off to near 0V when enough current is flowing through +PA to forward-bias Q203. Then, current though Q203 charges capacitor C209 through R214 to a voltage above the threshold voltage at the inverting input of comparator U201C. The overcurrent condition must persist for about 75 ms for C209 to charge above the threshold. The output of U201 goes high, turning on Q207. This forces the zener diode bias current to flow through Q207 instead of VR212 or VR216, leaving only a few volts at the gate of Q202, thus shutting +PA off. The output of U201C also saturates Q218 and reduces the comparator threshold voltage to near 0V. This provides the comparator with hysteresis; C209 has to discharge close to 0V before +PA can turn on again. The +PA supply cycles on and off as long as the overcurrent condition exists.

Transistor Q206 provides another current limit. While otherwise similar to the Q203 limit, the Q206 current limit turns on at 0.5A and turns off immediately without any delay. The Q206 limit thereby protects the supply under short circuit conditions.

Current limiting on the -PA side works similarly to the +PA side with one difference. That is that shutoff of -PA can happen under two circumstances:

- -PA is loaded beyond its current limit.
- +PA is shut off. (Shut off of -PA is slaved to shut off of +PA.)

Regulator/Guard Crossing Assembly (A17) 2-70.

The Regulator/Guard Crossing assembly (A17) provides two separate functions: voltage regulation for the analog power supplies, and digital control of the guard crossing. The voltage regulation portion is described first followed by the digital control portion. Refer to the schematic diagrams for the Regulator/Guard Crossing Assembly for this discussion.

VOLTAGE REGULATOR CIRCUITRY 2-71.

The regulator circuit receives unregulated dc from the regulator filter circuit on the Filter/PA Supply assembly (A18) and provides 13 regulated dc outputs and 1 unregulated dc output for the various analog assemblies. Table 2-10 lists the regulated supplies from the Regulator/Guard Crossing Assembly.

Table 2-10. Regulated Outputs from the Regulator/Guard Crossing Assembly

SIGNAL NAME	NOMINAL OUTPUT	TOLERANCE	CURRENT LIMIT	RATED OUTPUT	TEST POINT
+15 OSC	+15V	±800 mV	2A	200 mA	TP3
-15 OSC	-15V	±800 mV	2A	200 mA	TP5
+5RLH	+5.975V	±425 mV	2A	600 mA	TP14
+5LH	+5.1V	±300 mV	2A	600 mA	TP11
-5LH	-5V	±300 mV	2A	400 mA	TP15
+44S	+44.15V	±2.03V	0.5A	140 mA	TP13
-44S	-44.15V	±2.03V	0.5A	140 mA	TP16
+17S	+17.475V	±475 mV	4A	1.0A	TP8
-17S	-17.865V	±835 mV	6A	1.0A	TP12
+15S	+15V	±800 mV	2A	300 mA	TP18
-15S	-15V	±800 mV	2A	300 mA	TP19
+30FR1	+30.96V	±1.7V	1A	85 mA	TP2
+30FR2	+30.96V	±1.7V	1A	85 mA	TP7

REGULATED OSC SUPPLIES 2-72.

The +15 OSC and -15 OSC supplies are used exclusively by the Oscillator Output (A12) and Oscillator Control (A13) assemblies. OSC COM is the return path for these supplies. The +15 OSC uses the unregulated +15 OSCR from the Filter assembly and consists of three-terminal TO-220 regulator U2 with heat sink, bypass capacitors C1 and C2, and protection diodes CR2 and CR3. The -15 OSC uses the unregulated -15 OSCR from the Filter assembly and consists of three-terminal TO-220 regulator U3 with heat sink, bypass capacitors C4 and C5, and protection diodes CR5 and CR7. Capacitors C2 and C5 improve the stability of U2 and U3 respectively. Diodes CR3 and CR5 protect U2 and U3 from reverse voltages. Diodes CR2 and CR7 protect U2 and U3 from input shorts.

REGULATED LH SUPPLIES 2-73.

LH COM is the return path for the +5RLH, +5LH, -5LH and +8RLH supplies. The +5RLH, +8RLH, and +5LH supplies use the unregulated +5LHR supply from the Filter assembly. The +5RLH supply uses three-terminal TO-3 regulator U11 with heat sink, bypass capacitors C20 and C21, protection diodes CR17 and CR20, and the diode combination of CR34 and CR35. The +5LH supply uses three-terminal TO-3 regulator U8 with heat sink, bypass capacitor C16, protection diodes CR14 and CR16, and resistor R13. The -5LH supply uses the unregulated -5LHR from the Filter assembly and consists of three-terminal TO-220 regulator U12 with heat sink, bypass capacitors C23 and C24, and protection diodes CR21 and CR24. Capacitors C16, C21, and C24 improve the stability of U8, U11, and U12 respectively. Diodes CR14, CR17, and CR24 protect the regulators from input shorts. Diodes CR16, CR20, and CR21 protect the regulators from reverse voltage. Resistor R13 and diodes CR34 and CR35 increase the output of regulators U8 and U11. The unregulated +8RLH supply is generated by fusing the unregulated +5LHR supply from the Filter assembly with 3.15A slow-blow fuse F1.

REGULATED S SUPPLIES 2-74.

Line S COM is the return path for the +44S, -44S, +17S, -17S, +15S and -15S supplies. Line S COM is also connected to LH COM. The +44S supply uses the unregulated +44SR from the Filter assembly. This supply uses three-terminal TO-39 regulator U10, Q2, VR3, VR4, VR5, R20, R14, R15, CR18, CR19, CR25, C17, C18, C19, C65, PTC resistor R60. The regulator IC (U10) provides the current and thermal limiting. Its regulated output voltage is set by R14 and R15, yielding a nominal output of +44.15V. Components Q2, R20, VR3 and VR4 act as an emitter follower to protect the regulator against a potentially excessive input-output voltage differential in the event of a short circuit. Capacitor C65 filters this voltage to the regulator. Diodes CR19 and CR25 protect the regulator against shorts at the input, while CR18 protects the regulated output from reverse voltage. Capacitors C17 and C18 are for bypass. Capacitor C19 improves rejection of input variations. Components U10 and Q2 have heat sinks to provide thermal protection for both normal and short-circuit conditions. The regulator is shunted by R60 and VR5, which normally pass 28 mA of current to remove the power from the regulator. In an output short condition, the value of the PTC increases, limiting current through the device to less than 17 mA at 25°C.

The -44S supply uses the unregulated -44SR supply from the Filter assembly. This supply uses three-terminal TO-39 regulator U13, Q1, VR1, VR2, VR6, R17, R18, R19, PTC Resistor R61, CR22, CR23, CR32, CR33, C22, C25, C26, and C66. The regulator IC, U13, provides the current and thermal limiting. Its regulated output voltage is set by R17 and R18, yielding a nominal output of -44.15V. Components Q1, R19, VR1, VR2 and CR32 act as an emitter follower and protect the regulator against a potentially excessive input-output voltage differential if a short circuit occurs. Capacitor C66 filters the voltage to the regulator. The regulator is shunted by R61 and VR6, which pass 28 mA. In an output short condition, the value of the PTC increases, limiting current through the device to less than 17 mA at 25°C.

Diode CR32 removes VR2 from the circuit in a shorted condition to meet U13's input-output differential specifications. Diodes CR22 and CR33 protect the regulator against shorts at the output, while CR23 protects the regulated output from reverse voltage. Capacitors C25 and C26 are for bypass. Capacitor C22 improves rejection of any input variations. The heat sink on regulator U13 guarantees thermal protection for both normal and short-circuit operating conditions.

The +17S supply uses the unregulated +17SR supply from the Filter assembly. This supply uses three-terminal TO-3 regulator U6 with heat sink, and R5 and R6. The output voltage is set by resistors R5 and R6 in the same manner as the +44S supply. Capacitors C8 and C9 are for bypass. Capacitor C11 improves ripple rejection. Diodes CR8 and CR26 protect the regulator against shorts at the input, while CR11 protects the regulated output from reverse voltage.

The -17S supply uses the unregulated -17SR supply from the Filter assembly. It uses three-terminal TO-3 regulator U7 and R10 and R11. The output voltage is set by resistors R10 and R11 in the same manner as the -44S supply. Capacitors C13 and C15 are for bypass. Capacitor C14 improves ripple rejection. Diodes CR15 and CR27 protect the regulator against shorts at the input, while CR13 protects the regulated output from reverse voltage.

The +15S supply uses the unregulated +17SR supply from the Filter assembly. It consists of +15V three-terminal TO-220 regulator U4. Capacitor C27 is required for the stability of U4. Diode CR28 protects the regulator against shorts at the input, while CR29 protects the regulated output from reverse voltage.

The -15S supply uses the unregulated -17SR supply from the Filter assembly. It consists of -15V three-terminal TO-220 regulator U9. Capacitor C29 stabilizes U9. Diode CR31 protects the regulator against shorts at the output, while CR30 protects the regulated output from reverse voltage.

FR1 SUPPLY 2-75.

FR1 COM is the return path for the +30FR1 supply. This supply uses the unregulated +30FR1R supply from the Filter assembly and consists of three-terminal TO-39 regulator U1 with heat sink, bypass capacitors C3 and C6 and protection diodes CR1, CR4, and CR6. Resistors R1 and R2 set the output voltage in the same manner as the +44S supply. Capacitor C7 improves ripple rejection. Diodes CR1 and CR4 protect U1 against input shorts, while CR6 protects against reverse voltage.

FR2 SUPPLY 2-76.

FR2 COM is the return path for the +30FR2 supply. This supply uses the unregulated +30FR2R supply from the filter assembly and consists of three-terminal TO-39 regulator U5 with heat sink, bypass capacitors C10 and C28, and protection diodes CR9, CR10, and CR12. Resistors R4 and R8 set the output voltage in the same manner as the +44S supply. Capacitor C12 improves ripple rejection. Diodes CR9 and CR10 protect U5 against input shorts, while CR12 protects against reverse voltage.

GUARDED DIGITAL CONTROL CIRCUITRY 2-77.

The Inguard CPU controls all the analog assemblies. It communicates with the Unguarded CPU assembly (A20) through a serial fiber-optic link. The Inguard CPU is a Hitachi 637A01Y0 CMOS microcontroller (U56) with 16K x 8 bit (16 KB, or 16 kilobyte) internal CMOS EPROM. Support circuitry includes 8K x 8 bits (8 KB) of external CMOS static RAM, watchdog timer circuitry, reset and power glitch detect circuitry, test switches, a serial fiber-optic link to the unguarded CPU, and decoders and buffers to interface to the guarded digital bus. The assembly also generates an 8 MHz sine wave for use by some of the analog assemblies.

Inguard CPU Memory Map 2-78.

Table 2-11 shows the memory map of the Inguard processor.

Inguard Memory Configuration 2-79.

The microcontroller (U56) has 16 KB (kilobytes) of internal EPROM program memory. IC U62 provides 8 KB of external static CMOS RAM, with a jumper option for a plug-in replacement with a 2 KB device.

Inguard Clock Circuit 2-80.

This circuit uses 8 MHz crystal Y52 and step-down transformer T51 to generate a low-level (200 mV p-p) 8 MHz clock used by other guarded assemblies throughout the calibrator. Transformer (T51) has a center-tapped secondary, and provides CLK COM, CLK and CLK*. The CLK and CLK* sine-wave signals are sent to certain analog assemblies where they are converted into square wave clock signals for timing purposes.

Inguard Watchdog Timer 2-81.

The watchdog timer circuit uses a 74HC4020 (U59) and part of Programmable Logic Device (PLD) U58. The microcontroller (U56) generates a 19.2 kHz square wave (SCLK) on pin 11. The frequency of this clock is the same as the baud rate of the serial interface. Once the clock frequency is initialized, it runs without software supervision. This clock drives U59, which divides by 16384 to obtain a logic low interval of 427 ms followed by a logic high interval of 427 ms. The output of the U59, POPIN, goes to the PLD, which asserts POP to the analog hardware and NMIPOP* to the processor if U59 is not reset every 427 ms. The PLD also asserts POP on power-up and on any hardware reset. In order to prevent POP and NMIPOP*, the watchdog counter must be reset by reading or writing any analog hardware, or by toggling the POPCLRL line. The POPCLRL line is also used to disable the watchdog by going low.

Table 2-11. Inguard CPU Memory Map

ADDRESS SPACE (HEX)	NAME	USE
0000 - 0027		Internal Registers on the 6301
0028 - 003F		Unused memory space
0040 - 013F		Internal RAM 256 Bytes
0140 - 3FFF		Unused memory space
4000 - 4007	CS0*	Wideband Output (A5)
4008 - 400F	CS1*	Current/Hi-Res (A7)
4010 - 4017	CS2*	Switch Matrix (A8)
4018 - 401F	CS3*	Ohms Cal (A9)
4020 - 4027	CS4*	Unused
4028 - 402F	CS5*	DAC (A11)
4030 - 4037	CS6*	DAC (A11)
4038 - 403F	CS7*	Current/Hi-Res (A7)
4040 - 4047	CS8*	Oscillator Control (A12)
4048 - 404F	CS9*	Oscillator Output (A13)
4050 - 4057	CS10*	High Voltage Control (A14)
4058 - 405F	CS11*	Power Amplifier (A16)
4060 - 4067	CS12*	Rear Panel (A21) Boost
4068 - 406F	CS13*	Current/Hi-Res (A7)
4070 - 4077	CS14*	Wideband Oscillator (A6)
4078 - 407F	CS15*	Unused
4080 - 5FFF		Unused(memory overlay of 4000-407F)
6000 - 9FFF		Unused
A000 - BFFF		External RAM
C000 - FFFF		Internal ROM or EPROM

Power-Up and Reset Circuitry 2-82.

This circuit consists of U60, SW51, C55, C56, R52, and Z51. The line monitor chip (U60) detects three events: the power supply falling below 4.5V, reset being initiated by closure of momentary contact switch SW51, or BREAK being asserted from the break detection circuitry. If any of these conditions occurs, U60 resets the board for 130 ms. Pin 5 of U60 is an open-collector output, pulled high by pin 12 of Z51.

Break Detection 2-83.

The break-detect circuit acts as a serial communications break detector enabling the CPU assembly (A20) to reset U56 and U58 via the power-up and reset circuitry. This break-detect circuit uses a 74HC4020 binary counter (U63) and an inverter U51C. The microcontroller (U56) outputs the 1.2288 MHz ECLK clock on pin 64. This signal clocks U63, which in turn divides the signal by 16,384 to produce successive logic low and high intervals (each of 6.67 ms) at the BREAK output (U63, pin 3). Under normal conditions the RCV (receive) line is high to hold U63 clear. The main 68HC000 CPU can force a reset of the Guard Crossing over the fiber-optic link by holding RCV low for more than 6.67 ms, which causes BREAK to go high. BREAK, inverted by U51C, is used by the reset circuitry to force a Guard Crossing reset via RESET*.

Fiber-Optic Link to CPU 2-84.

Guarded digital and analog circuits are isolated from the unguarded CPU assembly (A20) by a fiber-optic link that asynchronously transmits serial data. On the transmit side, the microcontroller transmit output (XMT) controls a 75451 (U57) which drives fiber-optic transmitter J72 mounted on the Analog Motherboard. Receive signal RCV comes from fiber-optic receiver J71 also mounted on the Analog Motherboard. The receiver converts the light signal to TTL levels that become the RCV signal at the microcontroller. A fiber-optic cable links the fiber-optic transmitter on the Analog Motherboard to the fiber-optic receiver on the Digital Motherboard. Another fiber-optic cable links the other receiver/transmitter pair on the motherboards.

Interface to Guarded Digital Bus 2-85.

The interface to the guarded digital bus consists of a 74HCT245 (U55), a 74HCT244 (U52), two 74HC137s (U53 and U54), inverters U51B and U51D, resistor packs Z52, Z53, and Z54, and the POP line from U58. U52A and U52B buffer various control and address lines. Resistors from Z52 pull the lines of U52A to desired inactive states when BUSEN* is at a logic high, disabling the bus. U55 is a bi-directional data bus buffer (D0-D7). Resistor packs Z53 and Z54 match the lines of the buffered data bus, reducing reflected noise. ICs U53, U54, and U51D perform a 4-to-16 decode of address lines A3-A6, generating 16 chip-select lines (CS0*-CS15*) on the guarded digital bus. These 16 signals select the various assemblies on the Analog Motherboard. U51B buffers and inverts the INT interrupt signal from the DAC assembly. The POP signal from U58 is a reset line sent to the analog assemblies.

Inguard CPU Interrupts 2-86.

The Inguard CPU microprocessor handles many different interrupts. These are listed in Table 2-12 in order of priority with the highest priority interrupts first.

Switch Matrix Assembly (A8) 2-87.

Refer to Figure 2-7 for a simplified schematic of the Switch Matrix assembly (A8). The Switch Matrix assembly does the following tasks:

- Coordinates the flow of signals from each analog assembly (excepting the Wideband AC Module (Option -03)) to the calibrator's binding posts. This communication determines the calibrator's range.
- Coordinates the connection of various analog and digital common lines during operate, standby, and calibration modes.
- Controls such binding post functions as operate/standby, internal/external sense, and internal/external guard.
- Provides an internal cal zero amplifier used in the calibration of offsets for all dcv ranges (except the 1100V range).

The Switch Matrix assembly consists of 33 latching type, two- and four-pole relays. The relays are driven by special driver chips, which are controlled by the assembly's 24-output 82C55 chip. The Switch Matrix also contains the 5700A-4HR1 Temperature-Controlled Precision DC Amplifier Hybrid and RNET assembly, which is used when the calibrator is in the dc 2.2V or 220 mV range. The resistor network also is used to create resistive dividers to generate the ac or dc 220 mV, ac 22 mV, and ac 2 mV ranges. Additional analog circuitry in the Switch Matrix Assembly includes the dc 2.2V range output stage, the internal cal zero amplifier, FETs to support assembly calibration, assembly diagnostics, and circuitry to control some of the motherboard relays.

SWITCH MATRIX DIGITAL CONTROL 2-88.

Refer to sheet four of the Switch Matrix schematic diagram for the following discussion. The heart of the Switch Matrix digital control circuitry is an 82C55 Programmable Peripheral Interface IC (U1) under software control via the guarded digital bus. This IC has three ports that generate 24 outputs. These outputs are used to control eight UCN5801 Latching Driver ICs (U5-U12) controlling all Switch Matrix latching relays, one UCN5801 Latching Driver (U13) controlling the 10 non-latching relays on the motherboard, a 4028 decoder (U2), five FET switches (Q6-Q7, Q9-Q11), and an analog multiplexer (U4) for self diagnostics.

Table 2-12. Inguard CPU Interrupts

VECTOR		INTERRUPT	DESCRIPTION
MSB	LSB		
FFFE	FFFF	*RES	Power Up Reset
FFEE	FFEF	TRAP	Address error or op code error
FFFC	FFFD	!NMI	Non maskable interrupt (NMIPOPL)
FFFA	FFFB	SWI	UNUSED
FFF8	FFF9	!IRQ1	!IRQ1,ISF (A/DINTL)
FFF6	FFF7	ICI	Timer 1 input capture (unused)
FFF4	FFF5	OCI	Timer 1 output compare 1,2 (unused)
FFF2	FFF3	TOI	Timer 1 overflow (unused)
FFEC	FFED	CMI	Timer 2 counter match
FFEA	FFEB	!IRQ2	UNUSED
FFF0	FFF1	SIO	RDRF + ORFE + TDRE + PER

RDRF = Receive Data Register Full
ORFE = Overrun Framing Error
TDRE = TRANSMIT DATA REGISTER EMPTY
PER = Parity Error

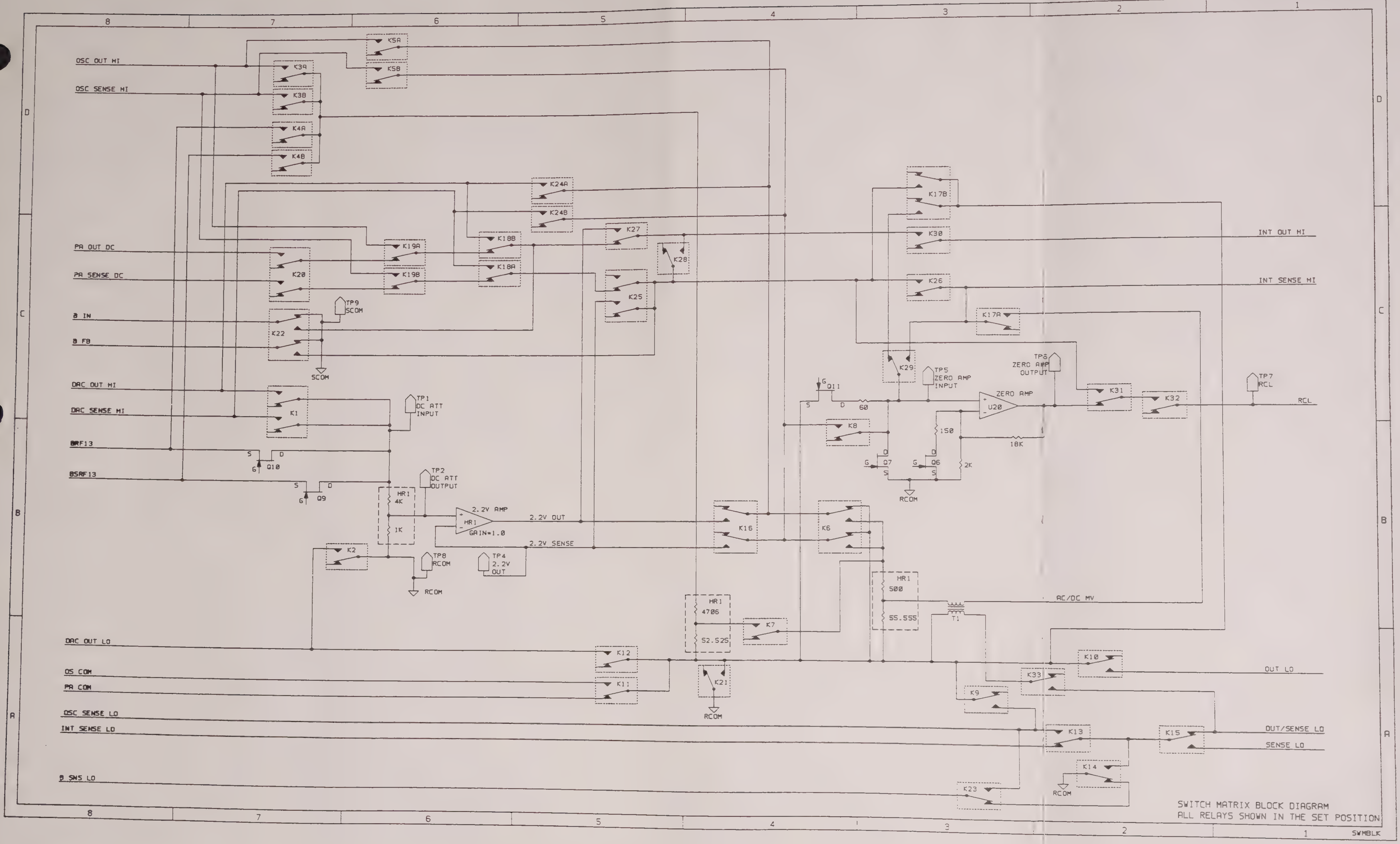


Figure 2-7. Switch Matrix Assembly Simplified Schematic

Eight UCN5801 latching driver ICs (U5-U12) drive Switch Matrix latching relays. Port A (PA0-PA7) from U1 provides a common input bus. Each driver chip has a separate strobe line. A 4028 decoder (U2) generates strobe lines U5STB-U13STB for strobing U5-U13 respectively. These individual strobe lines are decoded from PB0-PB3 of U1. When a strobe line is selected, the data on the bus is strobed in the respective driver chip. The output enables are controlled directly by PC0-PC3 of U1. One bit of port C enables two drivers. PC0 enables U5 and U6, PC1 enables U7 and U8, PC2 enables U9 and U10, and PC3 enables U11 and U12. By enabling only two driver ICs at a time, excessive power supply current draw is prevented. To ensure that the relays are latched properly, the driver chips must be enabled for 10 ms. As an example, the following steps are taken to set up relays in the first bank:

1. Write the proper data for the relays associated with driver U5 (K2, K9, K11, and K15) to port A of the 82C55.
2. Write 0 hex to PB0-PB3 to make U5STB go high. Now write 9 hex to PB0-PB3 to make all strobe lines go low. The data has now been strobed into U5.
3. Write the proper data for the relays associated with U6 (K3, K4, K5, and K24) to port A of the 82C55.
4. Write 1 hex to PB0-PB3 to make U6STB go high. Now write 9 hex to PB0-PB3 to make all strobe lines go low. The data has now been strobed into U6.
5. Write FE hex to port C (PC0 is low), wait 10 ms and write FF hex to port C. This takes the outputs of U5 and U6 out of tri-state and allows the proper relay coils to be energized for 10 ms.

A UCN5801 driver (U13) drives non-latching relays on the motherboard. The motherboard non-latching relay supply circuit, as outlined in sections A6 through A8 of the schematic diagram, contains U17, Q1, Q2, CR1, CR2, CR10, and R6-R12. Port A of U1 provides data for this driver (PA0-PA7), and decoder U2 provides the strobe signal. Since this driver controls non-latching relays, the enable is tied to LH COM.

The non-latching relay supply circuit provides approximately 7V to the relays on the motherboard during pull-in, and approximately 3.5V during normal operation. This voltage is routed to the motherboard on the RLY+V line. The 7V is needed to ensure pull-in while the 3.5V is sufficient to prevent drop out. This cuts relay heating and thermal EMFs. PC5 controls the non-inverting amplifier U17. This amplifier is the control element for Transistor Q1. When PC5 is low, the output is 3.5V, and when PB5 is high, the output is 7V. Components CR1, Q2 and R10-12 form a foldback current limit for the supply. The following steps are taken to select a particular state for Motherboard relays RLY1-RLY10:

1. Write the data corresponding to the desired state to port A (PA0-PA7) of the 82C55 (U1).
2. Strobe the data into U13 by writing 8 hex to PB0-PB3 to make U13STB go high, then a 9 hex to make it go low.
3. Apply 7V to the relay coils by setting PC5 high.
4. Wait approximately 20 ms for the relays to pull in, then reduce the coil voltage to 3.5V by setting PC5 low.

There are five FETs on the Switch Matrix. Q9 and Q10 (sheet 3, C7), which are N-channel JFETs controlled by port B (PB5) of U1, are driven by an LM393 open-collector comparator (U15A) to provide the proper level shifting. DMOS enhancement FETs are used for the remaining three FETs (Q6, Q7, and Q11). Refer to sheet 1, B5 of the schematic diagram. FETs Q6 and Q7 are driven by U1, port B, with a high on PB4 turning on Q6, and a logic high on PB7 turning on Q7. FET Q11 is driven on by a logic high from U1, port C (PC4).

The diagnostic circuit (sheet 4, B7) enables the calibrator to monitor +8RLH, the 2.2V range output voltage, +5RLH, -5LH, +17S, -17S, the assembly temperature (U3), and the OVEN TEMP line from the heated hybrid. OVEN TEMP, +5RLH, -5LH, and +8RLH are divided down by a factor of 11 by Z5 and Z6. A 4051 analog multiplexer (U4) is controlled by PA0-PA2 and PC6 from U1. This multiplexer selects which one of these eight voltages is applied to the SDL line, where it is measured by the adc circuit on the DAC assembly (A11).

SWITCH MATRIX OPERATION: 11V DC AND 22V DC RANGES 2-89.

Refer to Figure 2-8 for the following discussion. DC 11V and 22V ranges are generated by the DAC assembly and routed directly to the front panel binding posts through relays on the Switch Matrix and Motherboard.

Line DAC HI is connected to INT OUT HI through relays K18B, K27, and K30. INT OUT HI is connected to the OUTPUT HI binding post through relay K1 on the motherboard. Line DAC SENSE HI is connected to INT SENSE HI through relays K18A, K25, and K26. Motherboard relays K2 and K3 switch INT SENSE HI to the SENSE HI binding post during external sensing, or OUTPUT/SENSE HI during internal sensing.

Lines PA COM and DAC LO are connected by relays K11 and K12, and connected to the OUTPUT LO binding post by relay K10. Switch Matrix relays K14 and K15 connect R COM to the SENSE LO binding post during external sensing, or to OUTPUT/SENSE LO during internal sensing.

SWITCH MATRIX OPERATION: 2.2V AC AND 22V AC RANGES 2-90.

Refer to Figure 2-9 for the following discussion. AC 2.2V and 22V ranges are generated by the Oscillator assemblies and routed directly to the front panel binding posts through relays located on the Switch Matrix and Motherboard.

Line OSC OUT is connected to INT OUT HI through relays K19A, K18B, K27, and K30. INT OUT HI is connected to the OUTPUT HI binding post through relay K1 on the motherboard. Line OSC SENSE is connected to INT SENSE HI through relays K19B, K18A, K25, and K26. Motherboard relays K2 and K3 switch INT SENSE HI to the SENSE HI binding post during external sensing, or OUTPUT/SENSE HI during internal sensing.

Line OSC COM is connected to the OUTPUT LO binding post through relays K11 and K10 on the Switch Matrix. Switch Matrix relays K13 and K15 connect OSC SENSE LO to the SENSE LO binding post during external sensing, or OUTPUT/SENSE LO during internal sensing.

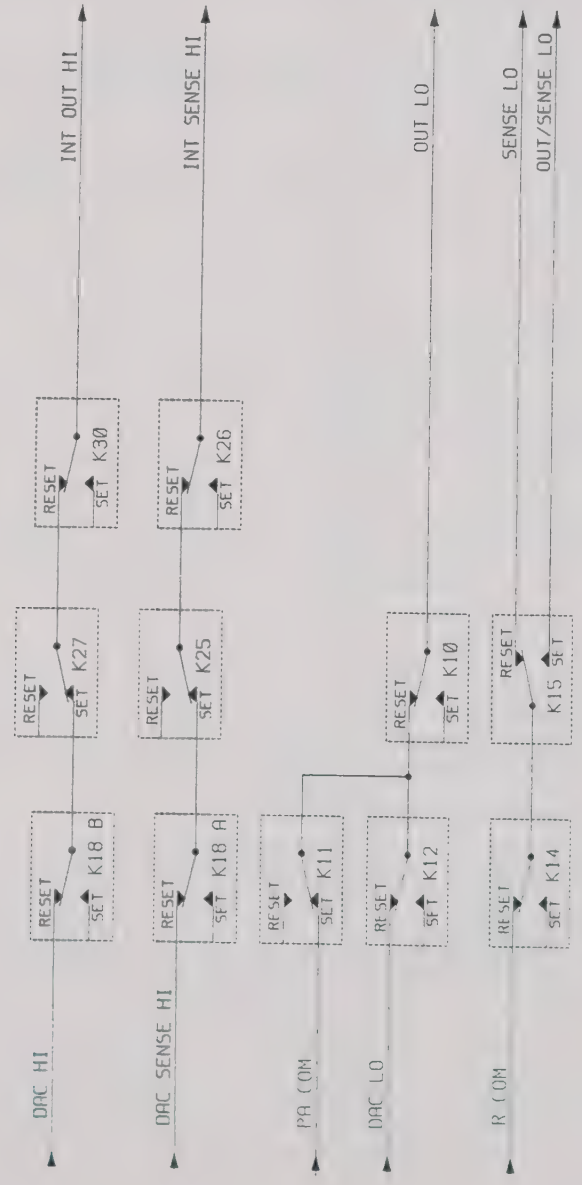


Figure 2-8. Switch Matrix Configuration for 11V DC and 22V DC Ranges

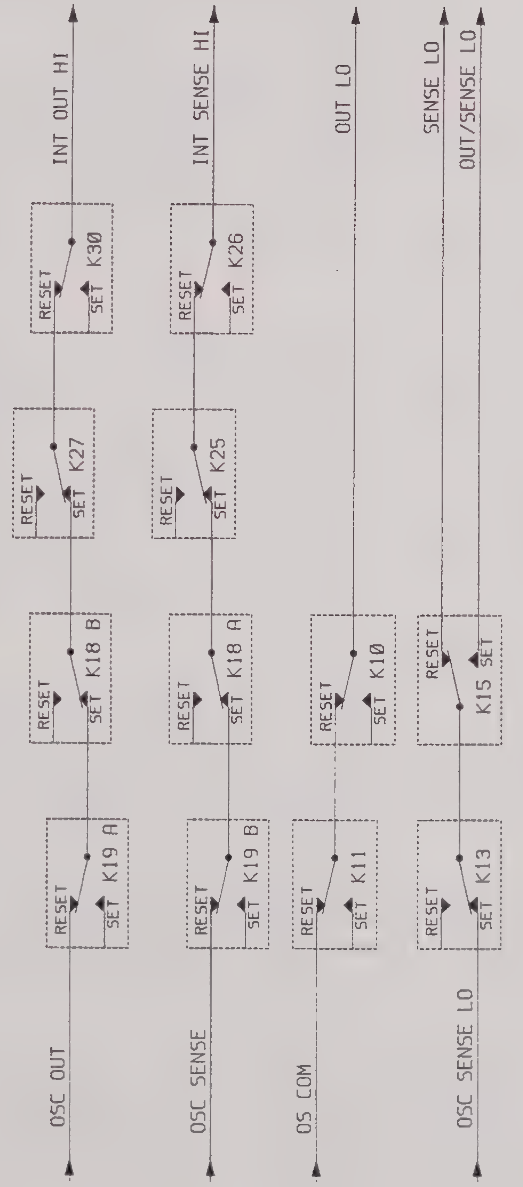


Figure 2-9. Switch Matrix Configuration for 2.2V and 22V AC Ranges

SWITCH MATRIX OPERATION: 220V AC AND DC RANGES 2-91.

Refer to Figure 2-10 for the following discussion. In the dc 220V range, PA OUT HI from the Power Amplifier assembly (A16) is routed to the High Voltage Control assembly (A14), where it goes through relay K10 and becomes PA OUT DC. Line PA OUT DC is routed to the Switch Matrix and connected to INT OUT HI through relays K20, K19A, K18B, K27 and K30. Relay K1 on the motherboard connects INT OUT HI to the OUTPUT HI binding post.

Line PA SENSE DC is connected to INT SENSE HI through relays K20, K19B, K18A, K25, and K26. Motherboard relays K2 and K3 switch INT SENSE HI to the SENSE HI binding post during external sensing, or OUT/SENSE HI during internal sensing. PA COM and DAC LO are connected by relays K11 and K12, and connected to the OUTPUT LO binding post by relay K10. Switch Matrix relays K14 and K15 connect R COM to the SENSE LO binding post during external sensing, or OUTPUT/SENSE LO during internal sensing.

In the ac 220V range, Power Amplifier outputs PA OUT HI and PA SNS AC are routed to the High Voltage Control assembly (A14) where relays K10, K3, and K13 connect them to HV OUT and HV SNS respectively. HV OUT is connected to the OUTPUT HI binding post through relays K9 and K1 on the motherboard. Motherboard relays K10, K2, and K3 connect HV SNS to the SENSE HI binding post during external sensing, or to OUTPUT/SENSE HI during internal sensing. Connection to the OUTPUT LO and SENSE LO binding posts is done with relays on the Switch Matrix. PA COM is connected to the OUTPUT LO binding post through relays K11 and K10. Switch Matrix Relays K13 and K15 connected OSC SENSE LO to the SENSE LO binding post during external sensing, or OUTPUT/SENSE LO during internal sensing.

SWITCH MATRIX OPERATION: 2.2V DC RANGE 2-92.

Refer to Figure 2-11 for the following discussion. The dc 2.2V range circuit consists of the dc 2.2V attenuator and a dc 2.2V range amplifier as outlined on sheet 3 of the Switch Matrix schematic. This circuit contains a CA3096 transistor array IC (U19A-E), transistor Q4, FETs Q12 and Q13, resistors R20, R23-R30, and R32, relays K1 and K2, part of the resistor network 4R07, and a dc amplifier heated hybrid.

The resistor network is bonded to the hybrid and this entire assembly is called the 5700A-4HR1 (HR1) on the schematic. Transistor Q3 drives the heater resistor on the hybrid. The heater control circuit adjusts the base voltage of Q3 to deliver the correct power to the heater resistor to maintain thermal control. Transistor Q8 protects the hybrid in case Q3 fails.

To produce the dc 2.2V range, the DAC assembly (A11) is set to the 11V range. DAC OUT HI and DAC SENSE HI are connected to pin 10 of the resistor network by relay K1, and DAC LO is connected to pin 9 by relay K2. The network divides the voltage by five. The divided voltage from pin 8 is connected to the input (pin 11) of the dc amplifier hybrid.

This temperature-controlled amplifier is used as a buffer amplifier. The output of the buffer amplifier (pin 18) drives the 2.2V range high current output stage consisting of U19, Q4, R25-R30, R32, and CR7-CR9. This circuit enables the 2.2V range to support 50 mA of current with current limiting. FETs Q12 and Q13 provide localized feedback for the precision dc amplifier during unusual conditions, such as a short circuit at the OUTPUT binding posts or when this range is in standby.

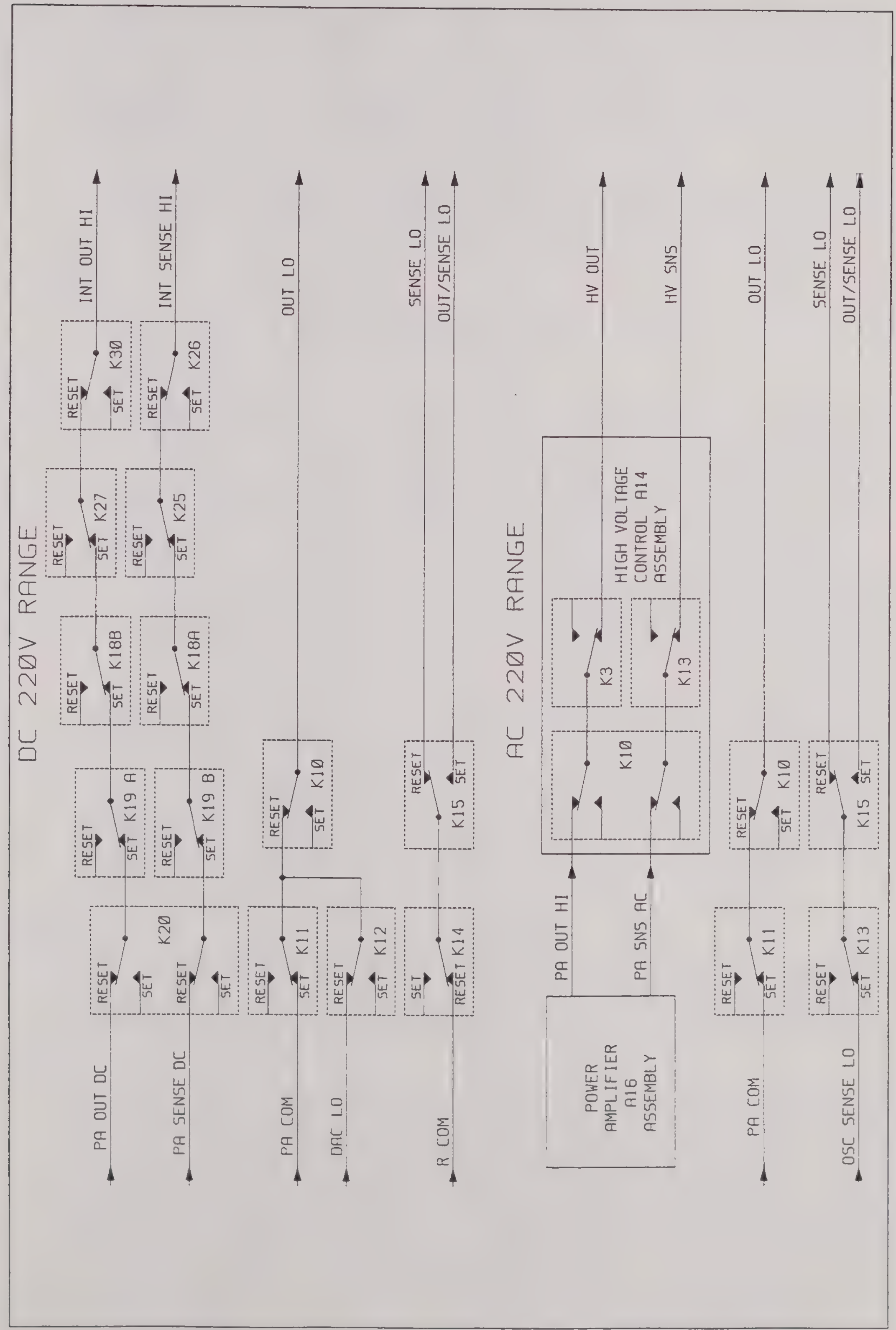


Figure 2-10. Switch Matrix Configuration for 220V DC and AC Ranges

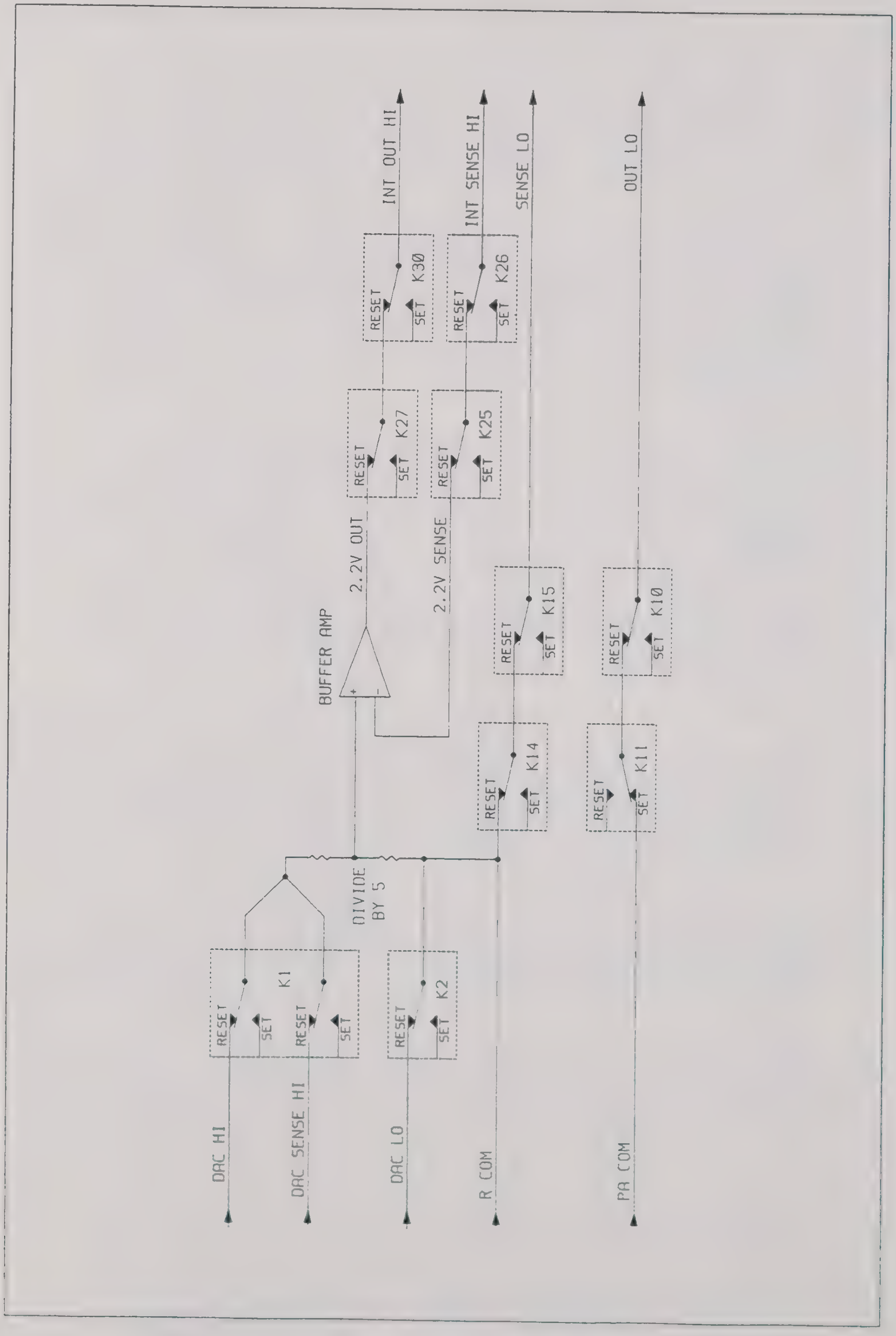


Figure 2-11. Switch Matrix Configuration for 2.2V DC Range

Line 2.2V OUT is connected to INT OUT HI through relays K27 and K30 on the Switch Matrix. Line INT OUT HI is connected to the OUTPUT HI binding post through relay K1 on the motherboard. Line 2.2V SENSE is connected to INT SENSE HI through relays K25 and K26 on the Switch Matrix. Motherboard relays K2 and K3 switch INT SENSE HI to the SENSE HI binding post during external sensing, or to OUTPUT/SENSE HI during internal sensing.

Line PA COM is connected to the OUTPUT LO binding post through relays K11 and K10. Switch Matrix relays K14 and K15 connect R COM to the SENSE LO binding post during external sensing, or OUTPUT/SENSE LO during internal sensing.

CALIBRATION OF THE 2.2V RANGE 2-93.

Refer to Figure 2-12 for the following discussion. Calibration of the 2.2V range involves determining its offset and gain constants.

To calibrate the offset:

1. The gain of the internal cal zero amplifier is set to 130 by turning on Q6 via PB4.
2. A checkpoint reading is taken, which represents 0V at the input of the internal cal zero amplifier. In this configuration, PB7 turns on FET Q7 connecting RCOM to the internal cal zero amplifier input, K29 is open (set position), and the output of the cal zero amplifier is connected to RCL via relays K31 and K32.
3. The input of the internal cal zero amplifier is connected to the output of the 2.2V range. The 2.2V range is adjusted until the adc reads the same as the checkpoint reading within the given tolerance. In this configuration, 2.2V OUT and 2.2V SENSE are tied together by relay K28 and the output (INT SENSE HI) of the range is channeled into the internal cal zero amplifier input (sheet 1) through relay K29.

To calibrate the gain of the 2.2V range, the 13V buffered reference (BRF13 and BSRF13) from the DAC assembly (A11) is connected to the input of the 2.2V range by FETs Q9 and Q10 on sheet 3 of the schematic. Since this network divides the voltage by five, a voltage of 2.6V is obtained at the 2.2V OUT and 2.2V SENSE points. These points are tied together by relay K28. This voltage is then channeled to the RCL line by relays K31 and K32 where it is connected to the +input of the adc amplifier on the DAC assembly (A11). The DAC output is connected to the -input of the adc amplifier and is adjusted until a null is achieved. At this point, the DAC voltage represents the output voltage of the 2.2V range. Gain is determined since the output, input, and offset of the 2.2V range are now known.

SWITCH MATRIX OPERATION: 220 mV DC RANGE 2-94.

Refer to Figure 2-13 for the following discussion. The 220 mV range is an extension of the dc 2.2V range. The 2.2V range is divided by ten to produce the 220 mV range. This 10:1 divider (on sheet 2 of the Switch Matrix Schematic) is part of the resistor network on the 4HR1 assembly.

The 220 mV range is passive with an output resistance of 50Ω. This range is generated by connecting the 2.2V OUT and 2.2V SENSE to pin 3 of the 10:1 divider by relays K16 and K6. Lines PA COM and R COM are connected to pin 2 of the 10:1 divider by relays K11 and K21. This divided output from pin 1 is called AC/DC mV on the schematic. This portion of the resistive attenuator is also used for generating the ac 2.2 mV and 22 mV ranges. The AC/DC mV signal is then connected to INT SENSE HI through relay K17A on sheet 1 of the Switch Matrix schematic. Line INT SENSE HI is connected to the OUTPUT HI binding post through relays K2 and K3 on the motherboard. Sensing for the LO occurs by connecting R COM and PA COM via K11 and K21. A single line is run out to the OUTPUT LO binding post by relay K33 on the Switch Matrix.

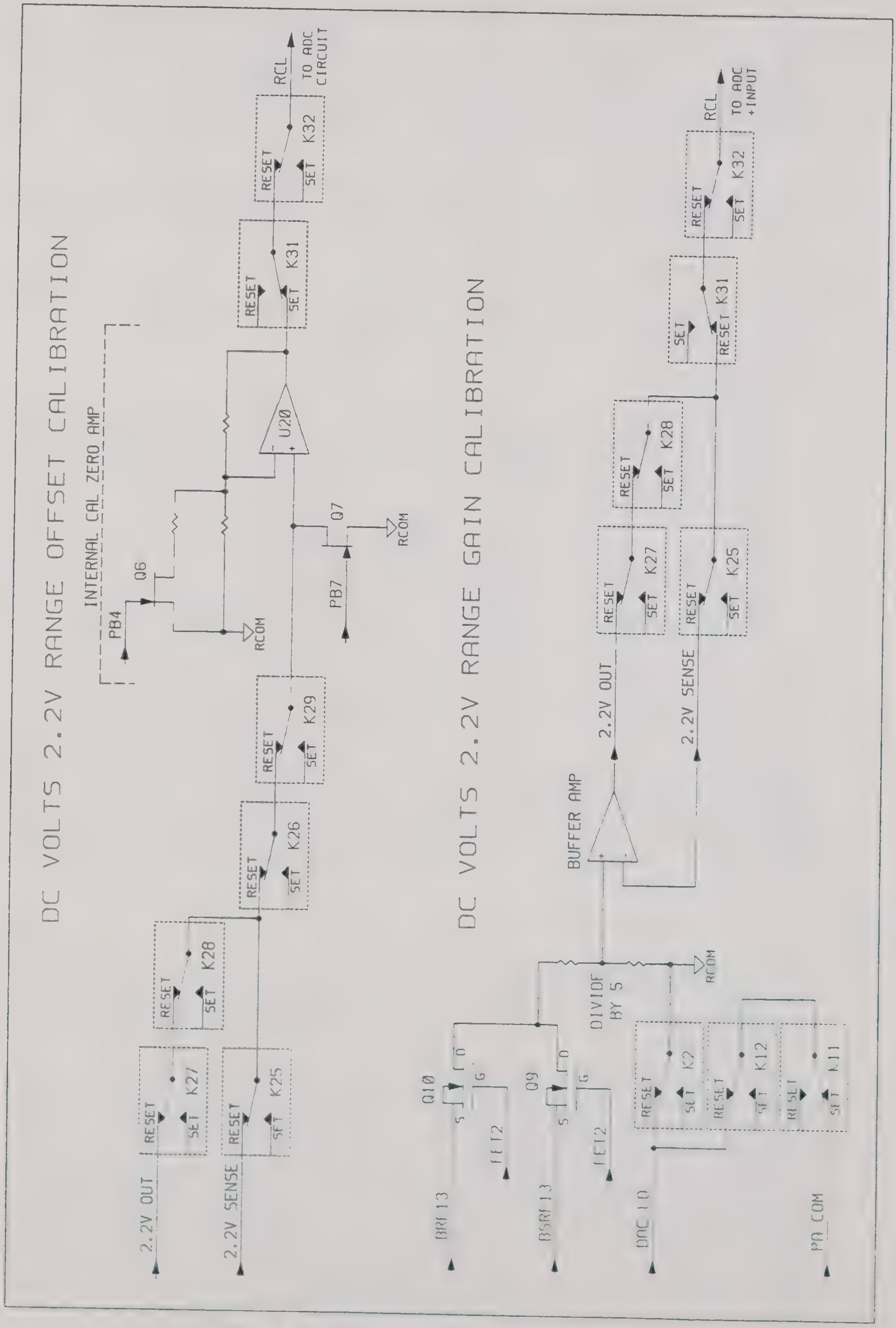


Figure 2-12. Calibration of the 2.2V DC Range

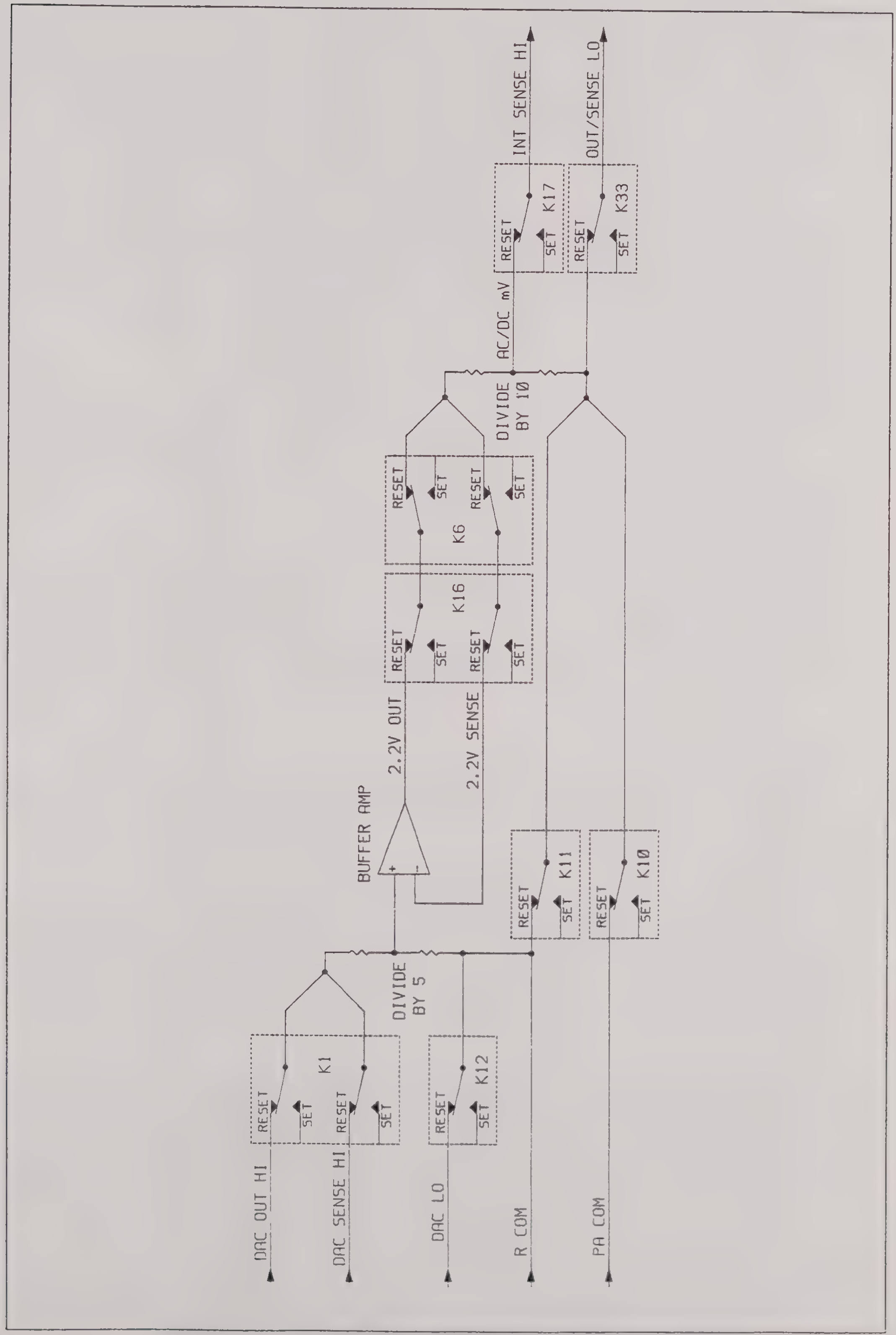


Figure 2-13. Switch Matrix Configuration for 220 mV DC Range

SWITCH MATRIX OPERATION: 220 mV AC RANGE 2-95.

Refer to Figure 2-14 for the following discussion. As previously mentioned, the ac 220 mV range uses the same resistor network as the dc 220 mV range. In generating the ac 220 mV range the Oscillator assembly is set to the 2.2V range. Lines OSC OUT and OSC SENSE are connected to pin 3 of the 10:1 divider by relays K5 and K6. Lines OS COM and OSC SENSE LO are connected to pin 2 by relays K11 and K9 respectively.

This divided output from pin 1 is referred to as AC/DC mV on the schematic. The AC/DC mV is then connected to INT SENSE HI through relay K17 on sheet 1 of the Switch Matrix schematic. Signal INT SENSE HI is connected to the OUTPUT HI binding post through relays K2 and K3 on the motherboard. Sensing for the LO occurs by connecting OS COM and OSC SENSE LO via K11 and K9. A single line is run out to the OUTPUT LO binding post by relay K33 on the Switch Matrix.

SWITCH MATRIX OPERATION: 2.2 mV AND 22 mV AC RANGES 2-96.

Refer to Figure 2-14 for the following discussion. The ac 2.2 mV and 22 mV ranges use the 100:1 divider and the 10:1 divider of resistor network on 4HR1 for a total division of 1000:1. Switch Matrix operation for these two ranges is the same. For the 2.2 mV range, the Oscillator assembly is set to the 2.2V range. For the 22 mV range, the Oscillator assembly is set to the 22V range.

Signals OS COM and OSC SENSE LO are connected to pin 6 of the 100:1 divider and pin 2 of the 10:1 divider by relays K11 and K9. OSC OUT and OSC SENSE are connected to the input (pin 7) of the 100:1 divider by relay K3 (A and B). The output of this 100:1 divider is then connected to the input of the 10:1 divider (pin 3) by relay K7. At the output of the 10:1 divider (called AC/DC mV on the schematic) there is a total division of 1000:1. Connection to the binding posts is done in the same manner as in the ac 220 mV range. In all cases, the output impedance of the millivolt ranges is 50Ω.

CALIBRATION OF THE mV RANGES 2-97.

Calibration of the mV ranges involves determining the resistor ratios of the 10:1 divider and the 1000:1 divider (100:1 and 10:1 dividers cascaded). In addition, an offset calibration is performed on the 10:1 divider to remove thermal EMF error for the 220 mV dc range.

Refer to Figure 2-15 for the following discussion. The 10:1 divider offset is calibrated by configuring the Switch Matrix for the 220 mV dc range, except with the output of the range (AC/DC mV) switched into the input of the internal cal amplifier through relays K17 and K29. The Calibration procedure is the same as described for the 2.2V range offset calibration except that during a checkpoint reading, control line PC4 turns on Q11 which connects SWM SENSE LO to the input of the zero amplifier, representing 0V for the 220 mV range.

Calibration of the 10:1 divider ratio is accomplished by connecting the DAC assembly output (DAC OUT HI and DAC SENSE HI) through relays K24 (A and B) and K6 to the input of the 10:1 divider. DAC LO, PA COM, and R COM are connected to the common of the 10:1 divider by relays K12, K11, and K21 respectively. The DAC output is set to 2.2V to produce approximately 0.22V at the output of the 10:1 divider (AC/DC mV). Relays K17 and K29 direct this voltage to the internal cal zero amplifier, which is configured for a gain of 10, giving 2.2V plus an unknown error at its output.

The equation for this output is the DAC output (2.2V) multiplied by the 10:1 divider ratio (unknown) multiplied by the internal cal zero amp gain (calibrated, approximately 10). Once the output of the internal cal zero amplifier is determined, the 10:1 divider ratio is the only unknown, so it can be calculated.

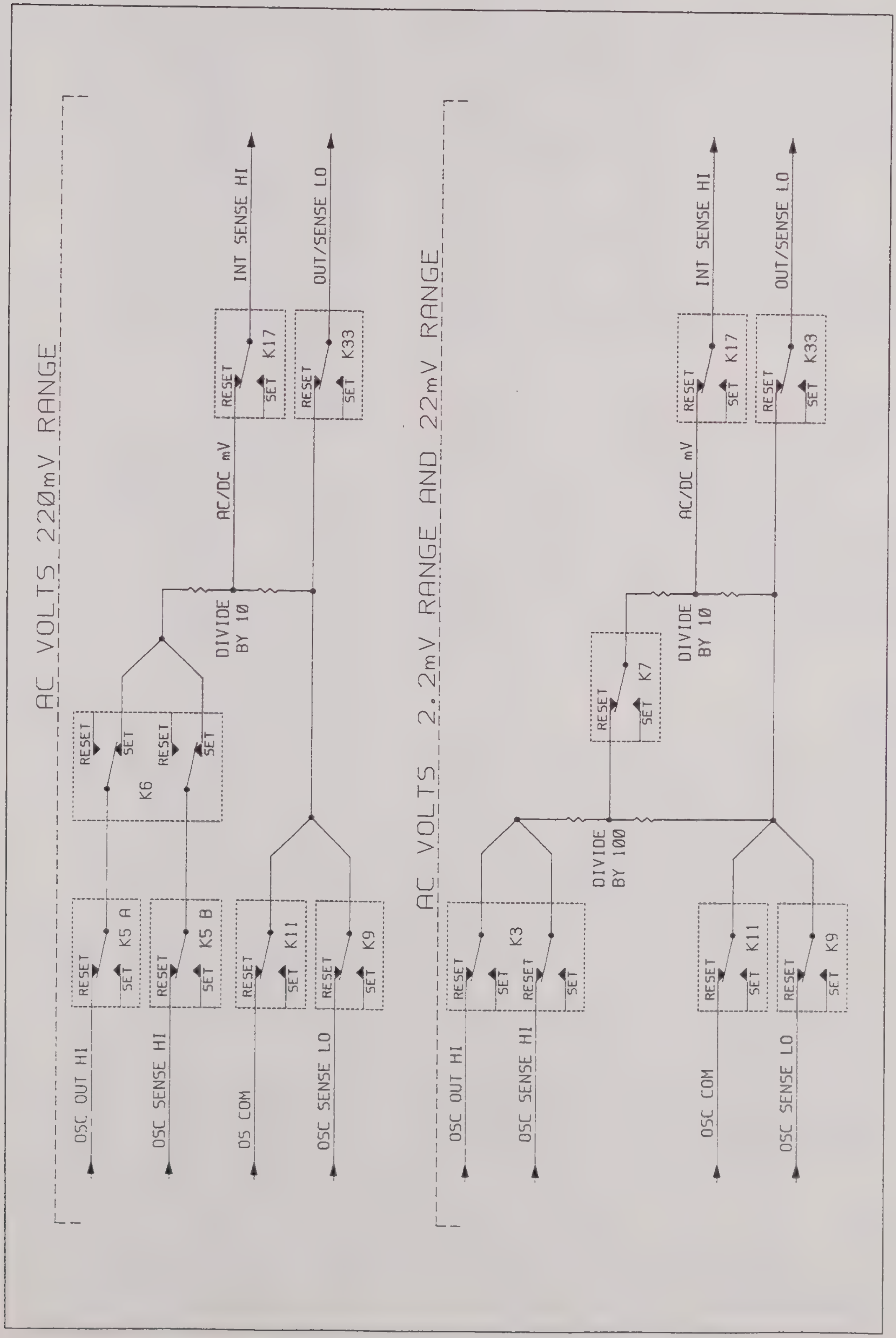


Figure 2-14. 220 mV AC, 2.2 mV AC, and 22 mV AC Range

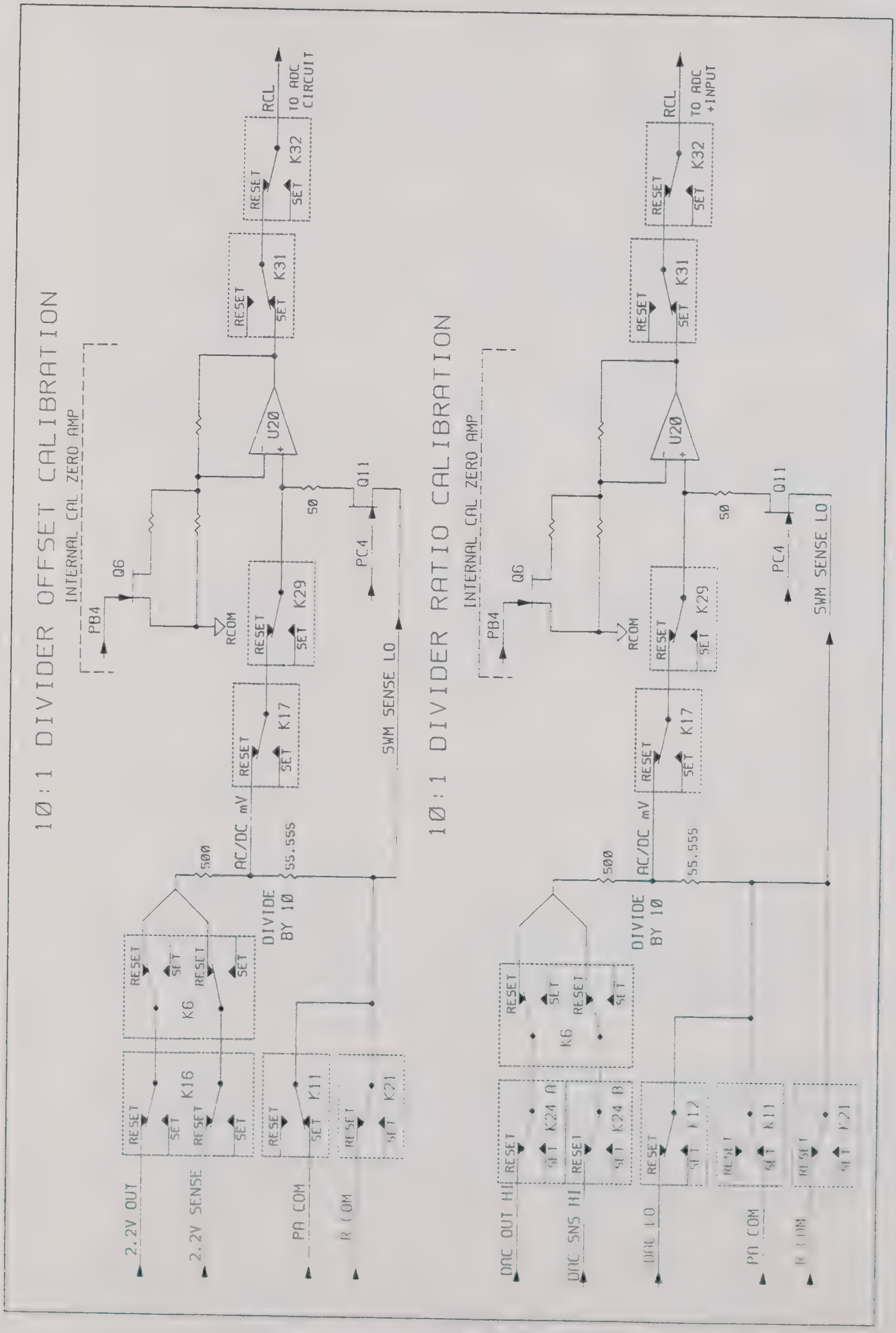


Figure 2-15. 10:1 Divider Calibration

To determine the output of the internal cal zero amplifier for this configuration, a checkpoint reading is first taken by connecting both inputs of the DAC's adc amplifier to the DAC output, which is set to 2.2V. This reading represents a null at 2.2V. The output of the internal cal zero amplifier is then channeled to the RCL line by relays K31 and K32 and to the +input of the adc amplifier on the DAC assembly with the DAC output still connected to the -input. An adc reading is now taken and the checkpoint reading is subtracted from it. This value is the adc's representation of the deviation of the internal cal zero amplifier output from 2.2V.

However, due to inaccuracy in the adc, an additional step must be taken. The -input of the adc amplifier is connected to RCOM and the +input to the DAC output. The DAC output is adjusted until the adc reads the previous value within the given tolerance. At this point, the DAC output voltage represents accurately the deviation of the internal cal zero amplifier output from 2.2V. The output of the internal cal zero amplifier is now calculated, allowing the 10:1 divider ratio to be determined.

Refer to Figure 2-16 for the following discussion. Calibration of the 100:1 divider ratio is similar to calibration of the 10:1 divider ratio. The 13V buffered reference (BRF13 and BSRF13) is connected to the input of the 100:1 divider pin 7 by relay K4 (A and B). DAC LO, PA COM , and R COM are connected to pin 6 of the 100:1 divider by relays K12, K11, and K21 respectively. The voltage at the divider output (pin 5) is approximately 0.13V. Relay K7 connects the output of the 100:1 divider to the input of the 10:1 divider. Relays K6 and K8 connect it to the ac mV CAL line, which is the input to the internal cal zero amplifier. The result is 1.3V at the amplifier output. This voltage is switched onto the RCL line by relays K31 and K32 to the DAC assembly, where the DAC is nulled to it. At this point, the DAC voltage represents the internal cal zero amplifier output and the 100:1 divider ratio is calculated.

INTERNAL CAL ZERO AMPLIFIER 2-98.

The main function of the internal cal zero amplifier is to remove the offsets of each of the dc ranges except the 1100V range. (The 1100V dc range is zeroed at the High Voltage/High Current assembly.) The internal cal zero amplifier is switched into two gain configurations for range zeroing; a gain of 130 for the 22V ranges and below, and a gain of 10 for the 220V range. Each range is channeled into the internal cal zero amplifier via relay K29. The range is then compared against 0V by connecting R COM to the amplifier via FET Q7. For the 220 mV range, the reading for 0V (or checkpoint reading) is taken by turning on Q11 instead of Q7 in order to achieve a 50Ω impedance. The output of the amplifier is connected to the RCL line by relays K31 and K32, and then channeled to the DAC assembly where the signal is measured by the adc.

The internal cal zero amplifier is outlined in a broken line rectangle on sheet 1 of the schematic. Its functional parts are U20-U21, R38-44, R46-47, Q6-7, Q11, and Z2. When Q7 is on, the input of the zero amplifier is connected to 0V for a reference point. When Q6 is on, the gain of the zero amplifier is 130. Op amp U21 and its associated resistors form a current-cancellation circuit. It senses the output of the zero amplifier and creates a current equal in magnitude but opposite in polarity to the current through the gain resistors (Z2), resulting in zero current in the precision common (RCOM).

SWITCH MATRIX 5725A AMPLIFIER INTERFACE 2-99.

The Switch Matrix also provides switching between the calibrator and the 5725 Amplifier. The ac and dc input signals necessary to operate the 5725A are connected by relay K22. Relay K23 connects B SNS LO to either OSC SENSE LO or R COM via relay K14.

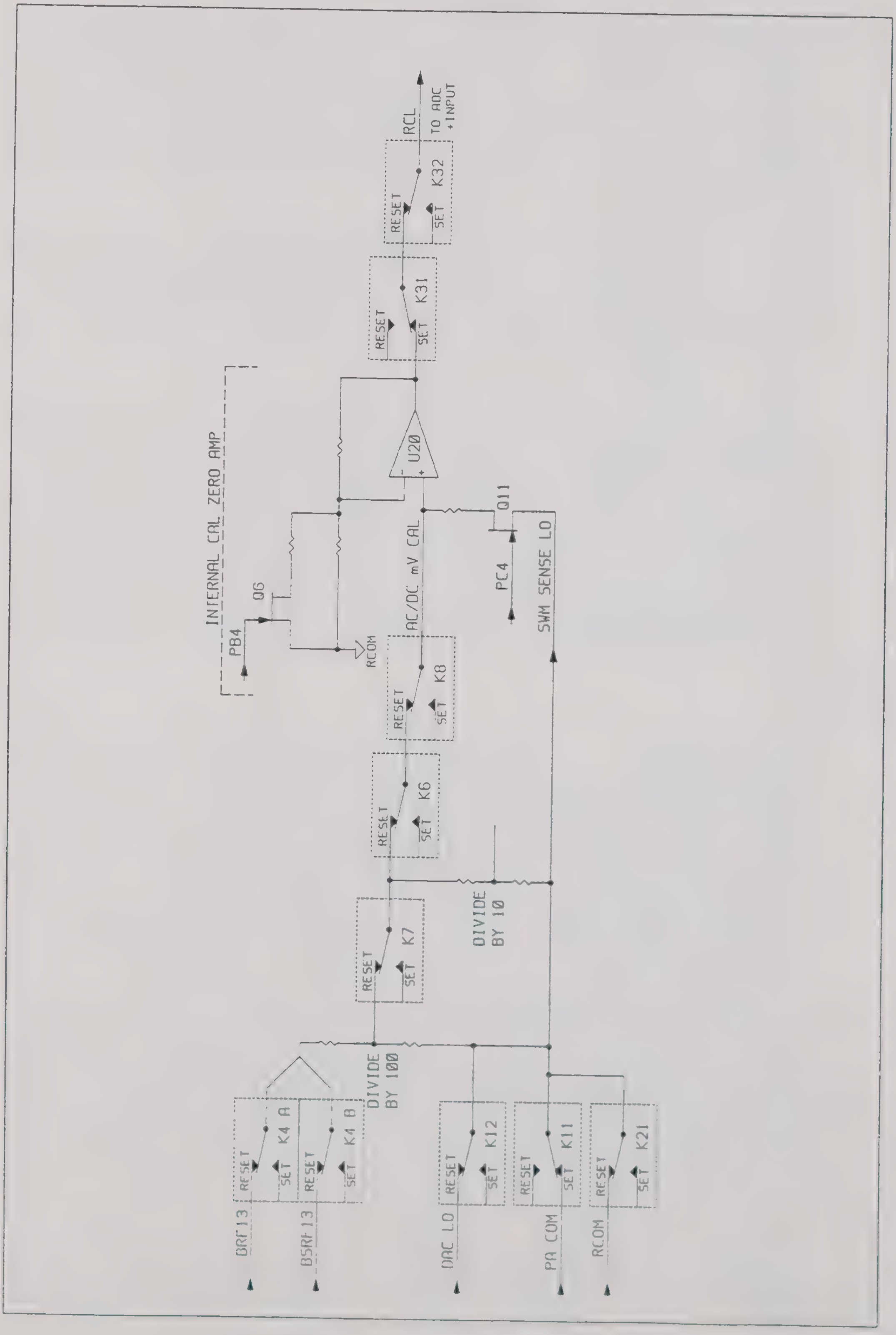


Figure 2-16. 100:1 Divider Gain Calibration

DAC Assembly (A11) 2-100.

The DAC (digital-to-analog converter) is the basic building block of the calibrator. Other assemblies create ac and dc voltages and currents with its precision dc voltage. The DAC contains five assemblies:

- DAC Main Board (A11)
- DAC Filter SIP (A11A1)
- DAC Buffered Reference SIP (A11A2)
- Reference Hybrid (HR5)
- DC Amplifier Hybrid (HR6).

The DAC assembly serves two main functions:

- To provide a highly repeatable stable dc voltage
- To support calibration of the calibrator

The DAC's adc circuit is used to accomplish calibration. It is made up of an analog to digital converter (adc) and the adc amplifier. Together, these are used to completely characterize the calibrator, using only one external voltage source and two external resistor standards.

BASIC DAC THEORY OF OPERATION 2-101.

Figure 2-17 is a simplified schematic of the DAC assembly. The DAC uses a pulse-width-modulated scheme to produce a precision dc voltage of 0V to 22V with positive and negative polarity. The DAC contains:

- A 13V temperature-controlled reference hybrid (HR5)
- Duty-cycle control circuitry
- A five-pole active filter (A11A1 assembly)
- An output stage
- Digital control circuitry

These basic subcircuits work together for a stable and linear dc voltage.

The DAC assembly also contains:

- A sense-cancellation circuit
- Linearity control circuits
- Negative offset circuit
- An output switching circuit

The two inputs of the five-pole filter are two precision square waves with different fixed amplitudes and independently variable duty cycles controlled by software. The filter's first input square wave is called the first channel. It is switched between the reference voltage (13V) and 0V.

The filter's second input square wave is called the second channel. It is switched between approximately 0.78 mV and 0V. Its amplitude is derived by resistively dividing the 13V reference. This second channel is used for extra resolution.

The filter rejects all ac components of the waveforms above 10 Hz. Since the frequency of the square waves is 190 Hz, the output of the filter is a dc voltage which is the sum of average voltages of the two waveforms. The Output Stage, which consists of the dc amplifier hybrid and the output buffer, isolates the filter output from the DAC output and gives current drive to the DAC output.

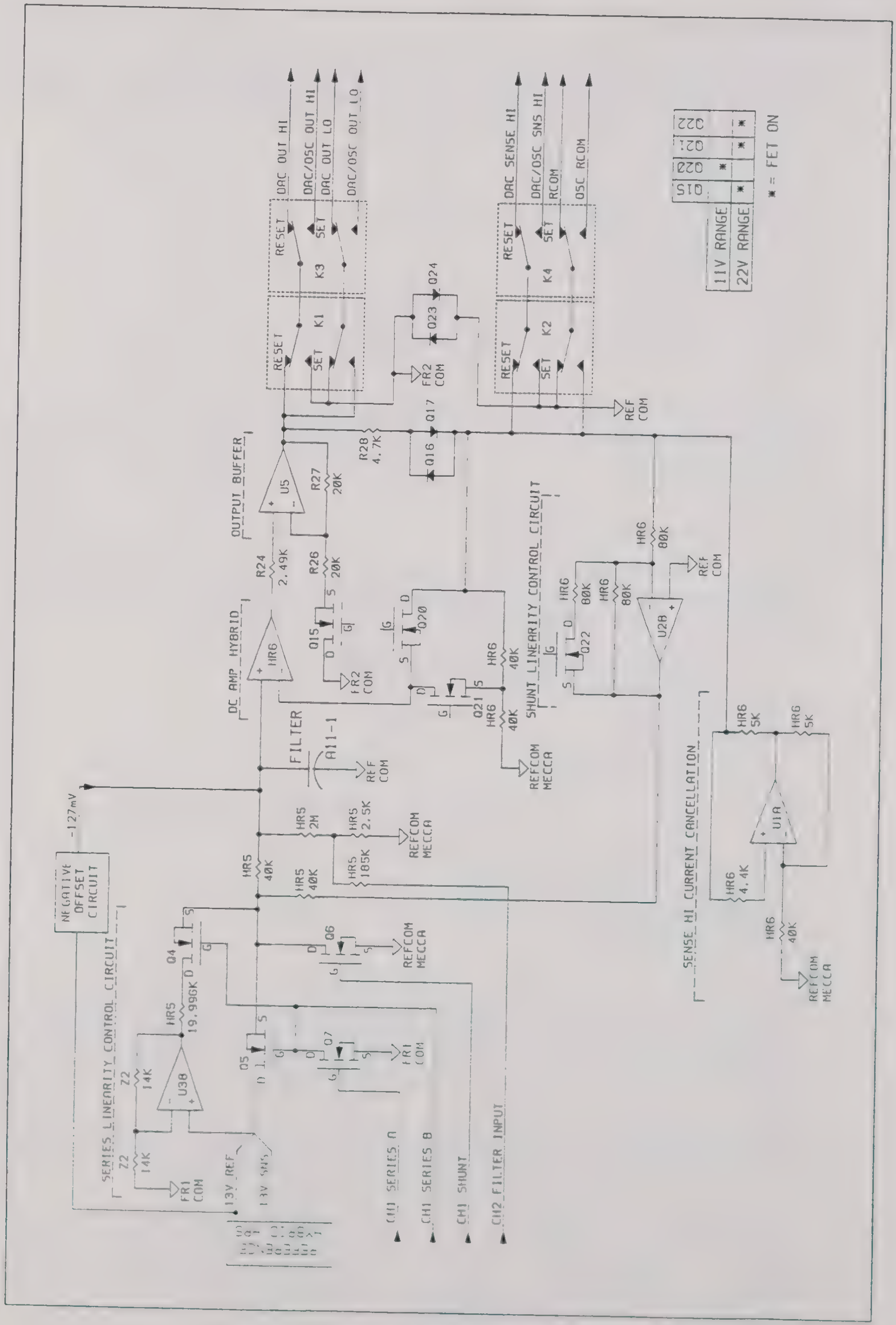


Figure 2-17. DAC Assembly Simplified Schematic

The output stage has a current limit of approximately 60 mA. It can be configured for a gain of one for the 11V range, or a gain of two for the 22V range. Relays on the DAC output lines allows them to be inverted for negative polarity.

To change the DAC voltage, the average value of the two square waves must be varied. To determine the average value, multiply the waveforms amplitude by its duty cycle. Vary the duty cycle and keep the amplitude fixed to change the DAC voltage.

For example, if the duty cycle of the first channel is 10% and the second channel 50%, the overall average voltage would be:

$(0.1 \times 13V) + (0.5 \times 0.78 \text{ mV}) = 1.300390V.$

The duty cycle resolution is 0.0024%, which gives a first channel resolution of 0.309 mV and second channel resolution of 18.5 nV.

The duty cycle control circuitry creates the two digital square waves for the first and second channels. These two waveforms are first run through optocouplers for isolation and then into analog switching and level shifting circuits. These circuits derive the proper signals to switch the input of the filter at the levels explained above.

DAC ASSEMBLY DIGITAL CONTROL 2-102.

The digital control circuit is located on sheet 6 of the DAC schematic. The 82C55 Programmable Peripheral Interface IC (U31) is the heart of this circuit.

This IC, which is under software control via the guarded digital bus, has three ports that provide 24 static lines. Port A (PA0-PA7) is configured as a read-only port register. It passes the adc readings from the ADC IC (U25) to the guarded digital bus.

PB0-PB4 of port B control relays K1-K4 and K6-K8 via relay drivers U33 and U34. PB0 is also control line DAC OUT SEL used to turn on FET Q25, via FET Q26, and connect RCOM to SCOM during calibrator operation in the ac function.

PC7 of port C, buffered by U8A, provides the enable for these relay drivers. Relay driver U33 controls latching relays K7 and K8. Outputs from U33 are also used by Relay driver U34 to control latching relays K1-K6. PB5-PB7 are decoded by U32 to create six control lines. These control lines are used to select one input to the adc amplifier -input. K5SEL is an input to the relay drivers to control latching relay K5. The remaining five control lines are used by comparators in U35 and U36. These comparators provide the proper level shifting to create control lines BSRF6 SEL, BSRF13 SEL, REF6 SEL, REF13 SEL, and ADC COM SEL. These control lines are used to control FETs on the DAC Buffered Reference SIP assembly (A11A2).

PC0 of port C is buffered by U8 (B and C) and routed through opto-isolator U37 to create RANGE SELECT, which sets the DAC to the 11V or 22V range. PC1 is used in the duty cycle control circuit to shut off the 8 MHz clock via buffer U8F and the first channel via OR gate U9D. This is done during calibrator operation in the resistance function. PC2 controls a FET in U23 for use in self-diagnostics. PC3 and PC4 are level-shifted by comparators in U36 before they are used to control FETs in U23. PC5 of port C is connected to a comparator in U36. This comparator provides the proper level shifting to create control line ADCAMP OUT SEL to control a FET in U23. PC6 is control line ADC TRIGGER which triggers the adc (analog-to-digital converter) IC U25. A0, A1, and CS*, from the guarded digital bus, are used by OR gates in U9 (B and C) to create control line ADC READ for use by the adc IC U25.

DAC ASSEMBLY REFERENCE CIRCUITRY 2-103.

The reference circuitry is on the reference hybrid, located on the HR5 assembly. The HR5 assembly contains a ceramic substrate reference hybrid bonded to a resistor network.

All components on this assembly are surface mount devices, except U6 and U7. The resistors are screened with a thick film paste. Associated resistors, capacitors, and zener diodes are mounted on the main board to supply this hybrid with the appropriate power and ground returns.

As previously explained, the amplitudes of the pulse width modulated signals for the first and second channel are assumed to be fixed. Any change in amplitude shows up as an error on the output of the DAC. Since the reference is used to determine the amplitude, it must be very stable and generate little noise.

The 13V reference contains two cascaded 6.5V temperature compensated transistor/zener diode pairs called ref amps (U6 and U7). The excellent temperature characteristics of the ref amps are obtained by biasing the collector current on their transistors with a value such that the TC (temperature coefficient) of its base-emitter junction cancels the TC of the zener diode. Since the base-emitter junction and the zener diode are in series, the result is a near zero TC.

Correct bias currents are achieved with a thin-film resistor network in a surface-mount package mounted on the hybrid.

The reference circuit is designed such that the effects of the thin-film resistors and op amp errors are second order. Thus, accuracy is determined almost entirely by the ref amps.

To further reduce the effects of ambient temperature variations, the hybrid is heated to a constant 62°C by the heater control circuitry on sheet 1 of the DAC schematic.

Temperature is sensed near the ref amps by a thermistor (RT1). If the substrate temperature changes, the thermistor resistance changes. This creates a correction voltage to the base of Q2 (on the main board). This, in turn, causes the power into the heater resistor, which is screened on the back of the substrate, to increase or decrease as necessary to maintain a stable temperature.

Thermal runaway is prevented by a protection circuit. Once the substrate temperature reaches approximately 67°C, the change in resistance of RT2 causes Q9 to turn on. As transistor Q9 turns on, it steals base current from Q1 on the main board, which brings it out of saturation. This breaks the current path through the heater resistor. This condition exists only if there is a failure.

The exact value of the reference is determined during calibration. Because of the stability of the reference, it can be used for future internal calibration procedures to remove short term errors in the calibrator.

The 13V output, REF13 HI, is from pin 9 and REF13 SENSE is on pin 12. Also, a 6.5V reference line, REF6, is brought out on pin 14 of the reference for use during calibration.

In order to make these reference voltages available to other assemblies, the 6.5V and 13V references are buffered on the DAC Buffered Reference SIP assembly (A11A2). This assembly also contains the circuitry to switch the references and buffered references into the input of the adc during calibrator calibration. Refer to the section on the DAC Buffered Reference SIP for more information.

DUTY-CYCLE CONTROL CIRCUIT 2-104.

Duty-cycle control circuitry is pictured on sheet 3 of the schematics. DAC output voltages are represented in software by what are called first and second channel counts. Each count is a 16-bit number which is sent to the DAC assembly via the guarded digital bus.

For example, a first channel count of 20,000 (in decimal) represents a DAC output voltage of approximately 6.5V (half the reference voltage).

The first function of the duty-cycle control circuitry is to convert each count into a stable, TTL level, square wave, with a duty cycle proportional to the numeric value of the count. This is accomplished with the 82C54 programmable interval timer (U6).

A low-level 8 MHz clock is generated on the Regulator/Guard Crossing assembly (A17) and routed to the DAC assembly via the motherboard. This low-level clock, CLK and CLK*, is amplified to a TTL level by comparator U7 to generate the 8 MHz clock which is used by U6 and the adc IC U25.

The 82C54 programmable interval timer receives its input counts from the guarded digital bus and creates the second channel signal on OUT2 (pin 20) and the first channel signal on OUT1 (pin 16).

The second channel signal is buffered by U8 (D and E) and runs through opto-isolator U12 to become CH2 FLOATING. This signal alternately turns FETs Q30 and Q32 on and off to turn the 3V source (called 3V) into a floating 3V pulse width modulated waveform called CH2 FILTER INPUT.

The 3V source is created from the 13V reference. The 13V reference is buffered by op amp U1B, configured as a voltage follower. The output from U1B is divided down to 3V by a 100 kΩ and 30 kΩ resistor in the HR5 assembly, creating 3V.

This 3V is again buffered by op amp U11, configured as a voltage follower, to create the 3V, which is switched by FETs Q30 and Q32. CH2 FILTER INPUT uses three resistors on the HR5 assembly to resistively divide its 3V amplitude by an additional factor of approximately 3800.

The first channel signal is buffered by U8 (G and H) and run through opto-isolator U13, to become CH1 FLOATING. Since the first channel is much more critical than the second, CH1 FLOATING is clocked into a flip flop (U14) to ensure an accurate waveform.

To clock in this waveform, the low-level 8 MHz clock (CLK and CLK*) from the Regulator/Guard Crossing assembly (A17) is isolated by transformer T1 and amplified to a TTL level by comparator U10. This generates the clock inputs for U14. The output Q1 (pin 5) from U14 creates CH1 SERIES A, which switches Q7. The output Q1* (pin 6) is inverted by Q35, creating CH1 SHUNT, which switches Q6. The output Q1*, which is a TTL level, is also amplified by components Q33, Q34, VR11, VR12, and R44-R46, so it switches from 0 to 18V, creating CH1 SERIES B, which switches Q4 and Q5.

The watchdog timer sets the first channel filter input to 0V if a failure occurs on the 8 MHz clock. This circuit uses a monostable multivibrator (one shot) U15, C63, and R48. The 8 MHz clock is divided to 4 MHz by U14. This 4 MHz clock is connected to U15 and discharges C63 to ground. If the 4 MHz clock stops, C63 charges up, causing the Q1 output of U15 to go low. This logic low on Q1 is connected to the preset pin of U14 (PRI), which causes its Q1 output high and its Q1* output low. This condition turns on the shunt switch and turns off the series switch, which forces the filter input to be REFCOM.

DAC FILTER CIRCUIT 2-105.

The dac filter circuit is located on the DAC Filter SIP (A11A1) assembly. The dominant pole of the filter is near 10 Hz. This gives 120 dB of rejection at 190 Hz.

The +30FR1 supply and 15V zener diode, VR1, create the 15V supply (15V) for the op amps in the filter circuit. 15V is also connected to the main DAC board, where it is used with R111 as a pull up for the RANGE SELECT control line.

DAC OUTPUT STAGE 2-106.

The output stage of the DAC assembly consists of the DC Amplifier Hybrid assembly (HR6) and the output buffer circuitry. Like the Reference Hybrid, the DC Amplifier Hybrid is constructed of surface-mount components (except precision op amp U2), on a ceramic substrate hybrid, bonded to a resistor network.

It is temperature-controlled by a heater control circuit in the same manner as explained on the Reference Hybrid. Transistor Q3 provides proper power to the heater resistor.

The DC Amplifier Hybrid consists of a precision op amp U2, with a bootstrapped power supply (Q1, Q2, R1-R4, VR1-VR2). The op amp has low noise and low offset. It is bootstrapped to improve the common-mode rejection in its noninverting configuration.

The DC Amplifier assembly interfaces with the output buffer (U5) to create the output stage. Control line RANGE SELECT configures this output stage for unity gain for the 11V range or a gain of 2 for the 22V range. In the 11V range, Q15 is turned off, which gives U5 unity gain, and Q20 is on, which gives the DC Amplifier unity gain.

In the 22V range, Q20 is off and Q21 is on, which switches in the 40 kΩ feedback resistors located on the HR6 assembly. Precise ratio matching of these resistors provides high accuracy in the 22V range.

FET Q15 is on in the 22V range so that the output of the dc amplifier is half the output of the DAC. This is necessary so that the output of the dc amplifier is approximately the same as its inputs, which allows the bootstrap circuit to work.

The output buffer (U5) provides drive for the DAC output. It is used in a feedback loop with the DC Amplifier Hybrid so that the dc accuracy is dependent upon the dc amplifier, and the output drive capability is dependent on the output buffer.

The output buffer is current-limited to a short circuit current of about 60 mA. The short-circuit protection circuitry works as follows:

1. The supply current is sensed by R23. When the output current of U5 reaches approximately 50 mA, the voltage across R23 is large enough to turn on Q10.
2. As Q10 turns on, the voltage across R20 increases, and pulls down the supply voltage at pin 4 of U5.
3. In order to prevent the supply of U5 from dropping below the input, Q8 saturates turning on Q11 which shorts the input to FR1 COM.
4. When the short is removed, R22 and C41 cause Q11 to turn off slowly, which prevents a large overshoot at the DAC output.

SENSE CURRENT CANCELLATION CIRCUIT 2-107.

This circuit uses op amp U1A and four resistors on the HR6 assembly. This circuit supplies the sense current of equal, but opposite, polarity to the feedback resistors in the 22V range. This eliminates current in the sense lead during external sensing.

LINEARITY CONTROL CIRCUIT 2-108.

The linearity control circuitry contains the series linearity control circuit and the shunt linearity control circuit, as outlined on the schematic. These linearity control circuits eliminate filter current in the series switch (Q5) and the shunt switch (Q6). This is necessary because Q5 and Q6 have finite resistance (3 to 5Ω) and a small mismatch in the resistances can cause a linearity error.

The series linearity control circuit uses op amp U38, resistor network Z2, and a single 19.996 kΩ resistor on the HR5 assembly. This circuit eliminates filter current in the series switch Q5.

When the series switch (FET Q5) is on, it connects the 13V reference to the first channel input of the filter, and FET Q4 is also turned on. This causes U38 to supply the current to the filter through the 19.996 kΩ resistor in HR5 and Q4, which makes the resistance from TP2 to TP5 look like near 0 ohms.

The shunt linearity control circuit uses op amp U2B, FET Q22, three 80 kΩ resistors on the HR6 assembly, and one resistor in the HR5 assembly.

Op amp U2B is configured as an amplifier with an inverting gain of 1 in the 11V range, and an inverting gain of 0.5 in the 22V range. This gain is determined by FET Q22 and the three 80 kΩ resistors in the HR6 assembly.

When the shunt switch (FET Q6) is on, connecting the input of the filter to REFCOM, the current from the filter flows through the two 40 kΩ resistor (pin 7 to pin 8) on the HR6 assembly to the output of U2B. This cancels out the current that would flow through Q6 which makes it look like 0Ω.

NEGATIVE OFFSET CIRCUIT 2-109.

This circuit creates a constant offset voltage of approximately -127 mV at the filter input. Thus, for a DAC output voltage of 0V, the first channel count must be approximately 400 to offset this negative voltage. This guarantees a minimum duty cycle pulse width of approximately 50 μs.

This minimum duty cycle is necessary to overcome the offset of the output stage and to allow the reference voltage to settle out after being switched into the filter input. Op amp U2A and two 20 kΩ resistors in HR6 form an amplifier with an inverting gain of 1. This amplifier input is the 13V reference which produces -13V at its output. This -13V is divided by resistors in the HR5 assembly to create the -127 mV on the filter input.

DAC OUTPUT SWITCHING 2-110.

The floating outputs of the DAC are switched with latching-type relays K1, K2, K3, K4, and K8.

Relays K1 and K2 determine the polarity of the DAC. In the reset position, the DAC output is positive. In the set position, output is negative. Relay K1 also generates DAC LO DIAG and DAC HI DIAG which are used by the adc circuit during DAC diagnostics.

Relays K3 and K4 switch the DAC to various assemblies. In the reset position, the DAC is available to all assemblies except the oscillator. Relays K3 and K4 are set during operation in the ac function so the DAC output is connected to the DAC/OSC lines which run only to the Oscillator assembly. Also during operation in the ac function, control line DAC OUT SEL turns on FET Q25, via FET Q26, to connect SCOM to RCOM.

Relay K8, when in the set position, allows the DAC to be sensed right on the output of the DAC assembly.

DAC BUFFERED REFERENCE SIP 2-111.

The DAC Buffered Reference SIP assembly (A11A2) has two main functions. First, it buffers the 6.5V and 13V references so they can be used by other assemblies.

The 6.5V reference, REF6, is buffered by op amps U1A and U2A which creates BRF6 and its sense line BSRF6. The 13V reference, REF13 FILT, is buffered by op amps U1B and U2B which creates BRF13 and its sense line BSRF13. These are routed to other assemblies in the calibrator for use during calibrator calibration.

Second, it allows the reference voltages, or the buffered reference voltages, to be switched to the REFCAL line, which is connected to the inverting input of the adc amplifier by K5 during calibration of the DAC assembly.

Control line REF6 SEL and FETs Q1 and Q2 connect the 6.5V reference REF6 to REFCAL.

Control line BSRF6 SEL and FETs Q5-Q7 tie BRF6 and BSRF6 together and connect them to REFCAL.

Control line REF13 SEL and FETs Q8 and Q9 connect the 13V reference REF13 to REFCAL.

Control line BSRF13 SEL and FETs Q12-Q14 tie BRF13 and BSRF13 together and connect them to REFCAL.

ADC COM can also be connected to REFCAL by FET Q15 and control line ADC COM SEL.

SELF-CALIBRATION HARDWARE 2-112.

The main components of the calibration hardware are the adc amplifier and the adc (analog to digital converter). This adc circuitry converts dc analog voltages into 22-bit binary numbers which the software interprets.

ADC AMPLIFIER 2-113.

ADC amplifier circuitry is located on sheet 4 of the DAC schematic. The adc amplifier is used like a null detector. It has two inputs (inverting and noninverting) and a single output with ADC AMP OUT and ADC AMP SENSE connected together.

The noninverting input (+INPUT) is switched between ADC COM, RCL, or DAC SENSE CAL by relays K6 and K7. DAC SENSE CAL is the output of the DAC and RCL is the calibration line which other assemblies use during their calibration.

The inverting input (-INPUT) is switched between DAC SENSE CAL and REFCAL by relay K5. ADC amplifier inputs are high impedance. The output voltage is the voltage difference between the inputs multiplied by the overall adc amplifier gain of 11.

To determine adc amplifier output, the following formula is used: (Noninverting input - inverting input) x 11 = adc amplifier output. For example, if the noninverting input is a 5.0V and the inverting input is at 5.1V, the output would be -1.1V. (The calculation for this example is (5.0V - 5.1V) x 11 = -1.1V.) Op amp U20A configured as an amplifier with an inverting gain of 1 is used to cancel the current in ADC COM generated from op amp U19A.

Zener diodes VR19 and VR20 keep the output of the adc amplifier from exceeding ±4.0V. Similarly, this protection is provided for the adc amplifier inputs by VR17, VR18, VR21 and VR22.

ADC INPUT SELECTION 2-114.

The input to the adc chip, U25, is selected by a quad FET analog switch array, U23. A large filter (R74 and C84) and a buffer (U24) are put on the adc input line to filter out 60 Hz and 190 Hz before it is connected to the adc chip input (pin 22).

During calibrator diagnostics, control line PC2 selects the SDL (system diagnostic line) line, which is used by other analog assemblies to monitor their diagnostic voltages.

During diagnostics of the DAC assembly control, line PC3 selects DAC HI DIAG which is divided by R79 and R84. Control line PC4 selects DCAMP HEATER and REF HEATER which are summed and divided by R80, R81, and R83.

Since DCAMP HEATER and REF HEATER are referenced to FR1 COM, DAC LO DIAG is buffered by U22 to provide the proper current return.

During calibrator calibration, control line ADC OUT SEL selects the output of the adc amplifier.

ADC CIRCUIT 2-115.

The adc (analog-to-digital converter) is shown on sheet 5 of the DAC schematic.

Most of the adc is contained on one chip (U25) which uses the Fluke-patented recirculating remainder technique.

The adc has rms noise of approximately 20 µV between readings. This is reduced by a factor of 5 by averaging the readings. The adc measures input voltages between -1.8V and +1.8V.

Hardware for the adc has four major sections external to adc IC U25. These sections are:

- ADC reference voltage
- ADC dac
- ADC comparator/amplifier
- Timing/data control circuitry.

The adc reference voltage circuit is made up of zener diodes VR29, VR30, and resistors R91-R93, which generate a 6.4V reference. This -6.4V is inverted by U27B to create the +6.4V reference and is also buffered by U27A and connected to U25. A reference common point for the adc reference is made by buffering ADC COM with op amps U20B and U26A, resulting in an isolated ADC COM. Buffering allows the common point to be referenced to ADC COM, yet current from R85, C89, C90, R93, VR29, and VR30 to return to SCOM through the output of the buffer instead of through ADC COM.

The adc dac contains the dac amplifier, U28B, and a binary ladder network consisting of resistors in Z10. Digitally controlled analog bit switches are contained in U25. The bit switches determine the output voltage of U28B by control of the binary ladder network. The output voltage of U28B can be varied from -1.95V to 1.95V.

The adc comparator/amplifier contains op amp U29, two remainder storage capacitors (C89 and C90), an autozero storage capacitor (C95), and several digitally-controlled analog switches in U25.

The supplies for U29 are bootstrapped off its input voltage. This circuitry includes U28A, VR31-VR34, R95-R100, Q56, Q57, and C97.

The timing/data control circuit is the digital portion of U25. This internal circuitry controls the adc by manipulating the switches in the adc comparator/amplifier and the bit switches in the adc dac.

An adc conversion cycle is triggered by the falling edge of control line ADC TRIGGER from the digital control circuit. Once triggered, the adc, under control by U25, generates five 6-bit nibbles without any further interaction.

Once the adc is triggered, it goes through five measurement cycles. Each cycle is made up of three functions, an autozero function, a compare function and a remainder store function. Figure 2-18 illustrates these three functions.

Before the adc is triggered, it stays in the autozero function. In this function, the adc dac is set to 0V with some offset error. Through U25, pin 3 of U29 is connected to ADC COM and pins 2 and 6 are connected together. In this function, the offset of the adc dac is stored on C95.

In the compare function, U29 compares the adc dac with the adc input (during the first pass) or the stored remainder (C89 or C90) during the remaining four passes. The voltage to be measured is switched into pin 3. The adc dac is connected to pin 2 and adjusted according to the polarity output of U29 resolving the voltage on pin 3. During this function the six bits of one nibble are determined.

During the remainder store function, U29 amplifies and stores the difference between the ADC INPUT and the adc dac output on one of the remainder storage capacitors, C89 or C90. In this function, U29 is configured by the adc as a difference amplifier with a gain of 16. The output of U29 is now the difference between the input voltage and the DAC voltage, multiplied by 16. This voltage is stored on C89 or C90.

On the next cycle, this remainder voltage is switched into U29 as the input voltage during the compare function.

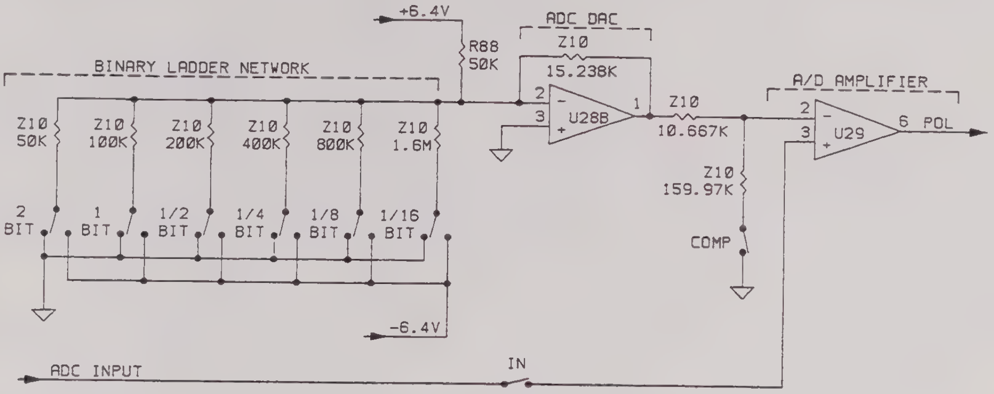
Once this is repeated five times, U25 sends out an interrupt signal (ADC INT) to tell the processor that it is waiting to read. To read the five passes of the adc, the processor reads port A of the 82C55 five times.

For the most critical applications, the adc measures the output of the adc amplifier. Since the output of the adc amplifier is adjusted until it reaches a checkpoint voltage, the adc needs only to be repeatable at this voltage and low in noise. This reduces the constraints on adc linearity and long term stability which allows a much simpler adc reference to be used.

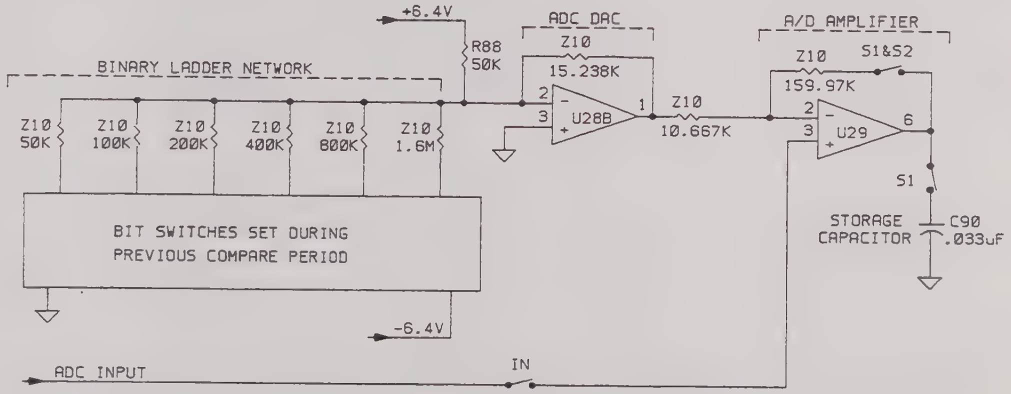
HOW THE DAC IS USED IN SELF-CALIBRATION 2-116.

For internal and external calibration, the adc amplifier output is switched to ADC INPUT.

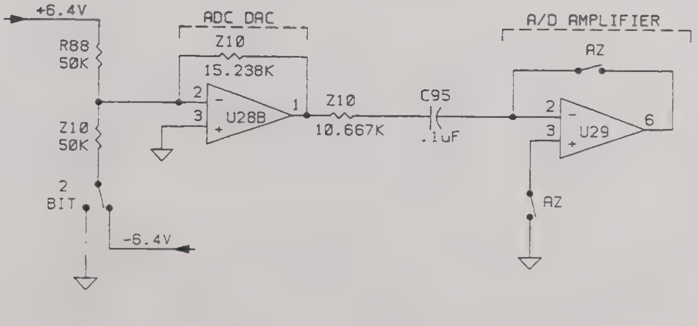
The adc amplifier acts as a null meter. It measures the voltage difference between its inverting and noninverting inputs and amplifies it by a gain of 11.



ADC DURING FIRST COMPARE PERIOD



ADC FIRST REMAINDER STORE PERIOD



ADC AUTOZERO PERIOD

Figure 2-18. ADC Circuit Measurement Functions

The adc amplifier can measure common-mode voltages up to 14V. Input switching circuitry allows the DAC SENSE, buffered and unbuffered reference, RCL, and ADC COM to be switched into the adc amplifier inputs.

To make a typical cal measurement, software sets the DAC to the approximate expected common-mode voltage. The DAC is then switched into both adc amplifier inputs and an adc reading is taken. This is the checkpoint measurement. It represents the adc amplifier common-mode and offset error, and the errors in the adc and adc amplifier input switching. The unknown voltage is switched into one input of the adc amplifier and the DAC is adjusted by software until the adc reading matches the checkpoint reading. At this point the unknown voltage is equal to the DAC voltage and is represented by the current DAC counts.

DAC ASSEMBLY CALIBRATION 2-117.

The DAC assembly is completely characterized using a single external 10V source. Calibration occurs in the following steps:

Ratio calibration of the first and second channels is performed first. The first channel count is set for a DAC output of near 0V. The second channel count is set to its minimum value of approximately 10,000. The DAC output is connected to the input of the zero amplifier on the Switch Matrix assembly (A8) and its output connected to the +input of the adc amplifier via the RCL line and the -input is connected to ADC COM.

The adc measures this value and stores it as a checkpoint reading. The first channel is decremented by one count and the second channel is increased until the adc reads the same as the previous checkpoint. The number of counts the second channel is increased represents the channel ratio constant.

The ±11V and ±22V range zeros are calibrated next. This is done by the same technique as the ratio cal except the checkpoint reading is obtained by connecting the input of the zero amplifier on the Switch Matrix assembly to RCOM. The DAC output (DAC SENSE CAL) is then connected to the zero amplifier input and adjusted until the adc reads the same as the previous checkpoint. This determines the exact first and second channel counts for a 0V output.

Next, the +11V and +22V range gain constants are calibrated by nulling the DAC to the external 10V source, connected to the front panel binding posts of the calibrator. This 10V source is connected to the RCL line by relays on the Switch Matrix assembly (A8).

The RCL line is connected to the +INPUT of the adc amplifier. The DAC output is connected to the -INPUT of the adc amplifier and is adjusted until the adc reads a null. This determines the first and second channel counts required for an exact 10 V output from the DAC. Software determines floating point gain constants from these counts.

The exact value of all the reference voltages (6.5V and 13V) are determined next. The reference voltage to be determined is connected to the -INPUT of the adc amplifier. The DAC output is connected to the +INPUT and adjusted until the adc reads a null. The reference voltage is the value to which the DAC is set. This procedure is done for the 6.5V buffered and unbuffered, and 13V buffered and unbuffered references.

Oscillator Section Overview 2-118.

The ac module consists of two plug-in assemblies, the Oscillator Output assembly (A13) and the Oscillator Control assembly (A12). These assemblies generate a precision amplitude-stabilized ac sine wave from 0.22V to 22V with a frequency range of 10 Hz to 1.2 MHz. This signal is either routed to the OUTPUT binding posts if the desired output is within this range, or used internally by the Power Amplifier, High Voltage, Wideband, Current, Switch Matrix, or an Auxiliary Amplifier (Model 5725A, 5205A, 5215A, or 5220A) for voltages and/or functions outside this range.

Output sensing of the amplitude helps obtain an accurate output signal regardless of output amplitude and load variations. Sensing is available for all voltage ranges above 200 mV at the calibrator SENSE binding posts. In the current function, and for voltages less than 200 mV, sensing is performed internally and output accuracy is guaranteed only for specified operating conditions.

The Oscillator Output assembly (A13) creates an ac voltage. The Oscillator Control assembly (A12) controls the amplitude of this ac signal by comparing the SENSE HI signal from the Oscillator Output with an accurate dc voltage from the DAC assembly (A11). The Oscillator Control assembly adjusts the amplitude of the Oscillator Output via the OSC CONT line. The frequency accuracy is controlled by the phase-locked loop circuit on the Oscillator Output assembly, which phase locks to the signal created by the Current/Hi-Res assembly (A7), or to an external signal connected to the 5700A rear panel through the PHASE LOCK IN jack.

The following discussions separately cover these two assemblies.

Oscillator Control Assembly (A12) 2-119.

The Oscillator Control assembly (A12) contains all the precision ac amplitude control circuitry except the output AGC amplifier, which is located on the Oscillator Output assembly (A13). The primary function of the Oscillator Control assembly is to monitor the output of the 5700A in the ac voltage function, and to adjust the output until the rms voltage across the SENSE point is equal to the voltage requested by the operator. This assembly provides amplitude control for both the ac current function and the Wideband AC Module (Option -03) during low-frequency operation.

The oscillator control circuitry contains an averaging converter, an error intergrator, a three-pole filter, an ac/dc thermal transfer circuit, an ac/ac thermal transfer circuit, a 15-bit dac, and a digital control circuit.

All power supplies used by this assembly are generated by the Guard Crossing/Regulator assembly (A17) except the +5 OSC supply, which is generated by a three-terminal +5V regulator (U25) from the +15 OSC supply. The ±15 OSC supplies are buffered by L3, L4, C34 and C35 to create the ±15A supplies, and L1, L2, C86 and C87 to create the ±15B supplies. A +2.5V reference voltage is created from the +5LH supply by resistors R52 and R53. A -200 mV reference voltage is created from the -15V OSC supply by resistors R57 and R58 for use exclusively by the protection circuitry for thermal sensors U14 and U16.

OSCILLATOR CONTROL DIGITAL CONTROL 2-120.

The digital control circuit contains an 82C55 Programmable Peripheral Interface (U20) and latching relay drivers (U23, U24). The 82C55 is controlled via the guarded digital bus, and has three ports that generate 24 outputs. Port A (PA0-PA7) is a common input bus (DATA) for the relay drivers (U23, U24) and the 14-bit DAC (U10). Relay driver U23, which controls latching relays K1 through K4, K6, and K8, is strobed by PC5 and enabled by PC7 of port C. Relay driver U24, which controls latching relays K5, K7, and K9, is strobed by PC6 and enabled by PC7 of port C. The SW control bus contains control lines SW1-SW4 from PB4-PB7 of port B which control a CMOS analog switch IC U19. PC1-PC4 of port C create control lines GCAL, AC*/DC, DAC* and BIT14* respectively. The Oscillator Output assembly (A13) generates two more control lines: LFCOMP* and HFCOMP*. These control lines are routed to this assembly via the motherboard and enter on pins 18A/C and 19A/C of connector P502.

A self-diagnostic circuit contains a multiplexer (U18) and resistor networks Z5 and Z6. It monitors ±15V, VREF, and the outputs of the error integrator and 14-bit DAC. These inputs are divided by the resistor networks, while U18 applies one to the SDL line. The SDL line is routed to the DAC assembly (A11) to be measured by the adc circuit.

OSCILLATOR INPUT SWITCHING 2-121.

Relay K1 selects an input to the Oscillator Control assembly. During ac voltage operation, relay K1 is reset. This connects the input (SENSE HI) to the averaging converter and the ac sense buffer to OSC SENSE HI. The reference voltage, VREF, is connected to both DAC/OSC OUT HI and DAC/OSC SENSE HI, which is the dc voltage from the DAC assembly (A11). During internal calibration K1 is set, so VREF is the 6.5V reference voltage (BRF6 and BSRF6) from the DAC assembly. The input to the averaging converter and ac sense buffer is DAC/OSC OUT HI and DAC/OSC SENSE HI from the DAC assembly.

SENSE CURRENT CANCELLATION 2-122.

The SENSE HI current cancellation circuit, containing op amp U1, Q1, Q2, K8, K2B and associated components, supplies the current into SENSE HI (Z2 pin 1) so that no current is pulled from the OSC SENSE HI line. During operation in the 2.2V and 22V, range K8 is set so the input is OSC OUT. In the 220V range K8 is reset so OSC SENSE HI is connected to the input. Relay K2B is reset in the 2.2V range and set in the 22V range. Transistors Q1 and Q2 form a bootstrapped supply for U1.

The SENSE LO current cancellation circuit, built around op amp U2, forces the return current back to SCOM instead of OSC SENSE LO. Relay K2A is reset in the 2.2V range and set in the 22V range.

To better understand the detailed circuit descriptions for the averaging converter, error intergrator, and three-pole filter, refer to Figure 2-19.

AVERAGING CONVERTER 2-123.

The averaging converter contains the buffer amplifier and rectifying amplifier circuits as outlined on sheet 1 of the schematic.

The buffer amplifier is a non-inverting unity gain amplifier (U3). Input to the buffer amplifier is either a 0 or 20 dB attenuator contained in Z2 as selected by K3. In the 2.2V range, SENSE HI is connected directly to the buffer amplifier with K3 in the reset position. In the 22V range, K3 is in the set position, so the buffer amplifier input (SENSE HI) is attenuated 20 dB by the 18 kΩ and 2 kΩ resistors in Z2. The buffer amplifier output voltage is always between 0.22 and 2.2V, and is capacitively coupled to the rectifying amplifier by C22 and C25.

The rectifying amplifier is comprised of U5, U7, Q3 and Q4, and has an inverting gain of 2. When the input voltage (from the buffer amp) is positive, feedback is negative through CR5 and a 2 kΩ resistor in Z1 (pins 6 and 5). When the input voltage is negative, the feedback path is through CR4 and a different 2 kΩ resistor in Z1 (pins 3 and 5). This amplifier produces a full-wave rectified negative output current proportional to input voltage. Output current is summed at the input of the error intergrator with the positive adjustable reference current (VREF, which is the output of the DAC assembly).

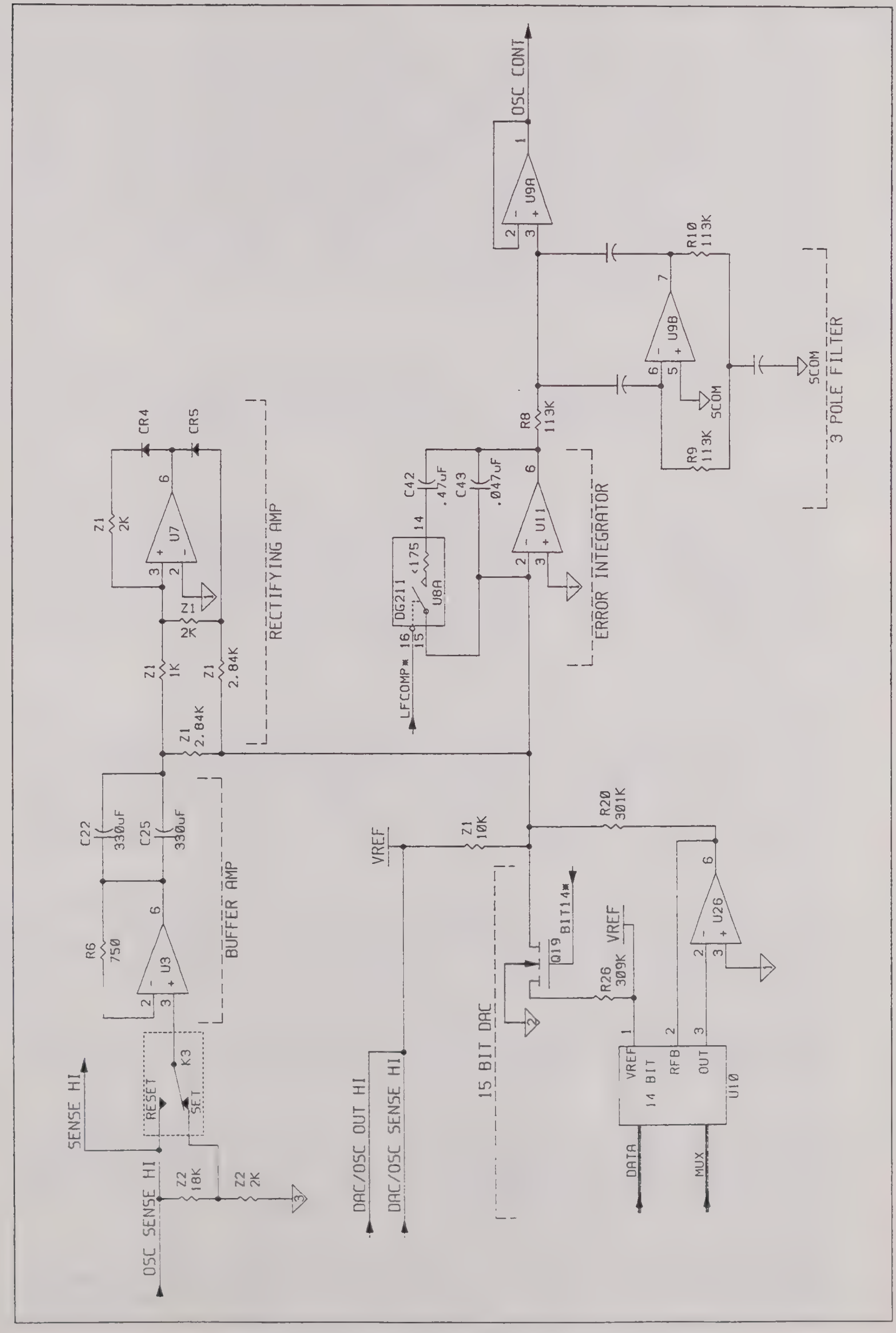


Figure 2-19. Oscillator Control Analog Control Loop

ERROR INTEGRATOR 2-124.

The error integrator circuit contains op amp U11, CMOS analog switch U8A, and capacitors C42 and C43. When operating at frequencies above 119 Hz, op amp U11 and C43 form an integrator. When operating at frequencies below 119 Hz, control line LFCOMP* goes low to close U8A, adding C42 to C43. This reduces the integrator crossover point by a factor of ten. If the magnitude of the averaging converter dc output current is different than the reference current, the output of the error integrator begins to change. Error integrator output goes through a three-pole filter and is buffered by U9A to generate OSC CONT. OSC CONT is routed to the Oscillator Output assembly to adjust the Oscillator amplitude. The output of the error integrator is also monitored by the diagnostic circuit via ERROR INT. OUT.

THREE-POLE FILTER 2-125.

The three-pole filter contains op amp U9B, CMOS analog switches U8B-U8D, and C26-C31. This circuit filters out ac from the output of the error integrator. Control line LFCOMP* goes low when operating at 119 Hz or less to reduce the crossover point.

ANALOG AMPLITUDE CONTROL LOOP 2-126.

This loop is comprised of the averaging converter, error integrator, three-pole filter, and the agc amplifier on the Oscillator Output assembly (A13). It stabilizes the 5700A output voltage in the presence of load changes. This loop by itself is very stable but does not have the conversion accuracy or gain flatness necessary to meet the precise amplitude specifications of the 5700A. Thus this circuit is used only to provide quick load regulation recovery and short term output stability.

AC/DC THERMAL TRANSFER CIRCUIT 2-127.

Refer to Figure 2-20 for the following discussion. The ac/dc thermal transfer circuit achieves basic mid-band amplitude accuracy. This is done by first applying the reference voltage (VREF) to the thermal rms sensor (U14) and measuring the output. Next, the ac voltage is applied to the thermal rms sensor and the dc output is compared to the previous reading. The sensor detects the difference between the ac and dc input voltages to within a few ppm.

If there is an ac/dc difference, the dc reference current applied to the error integrator of the analog control loop is adjusted via the 15-bit dac until the ac/dc difference is zero. The ac/dc thermal transfer circuit that performs this function is further described in detail. It contains the dc sense buffer, ac sense buffer, ac/dc thermal sensor, and the square-root amplifier and 15-bit dac as outlined on the schematic.

As previously mentioned, the input to the thermal rms sensor is either the dc reference voltage (VREF) buffered by the dc sense buffer or the ac voltage (SENSE HI) buffered by the ac sense buffer.

The dc sense buffer circuit uses op amp U30 as a buffer amplifier. Enhanced-mode FET Q10 provides feedback for U30 while FETs Q8 and Q9 are off. During a dc transfer, control line AC*/DC and comparator U21C turn on the FETs, applying the output of the dc sense buffer to the input of thermal rms sensor U14.

The ac sense buffer circuit contains op amps U12A, U12B, U13; FETs Q6, Q7, Q11, Q12; relay K4, and associated components. Relay K4 selects the input resistance to amplifier U13, which has a nominal inverting gain of 0.316 in the 22V range and 3.16 in the 2.2V range.

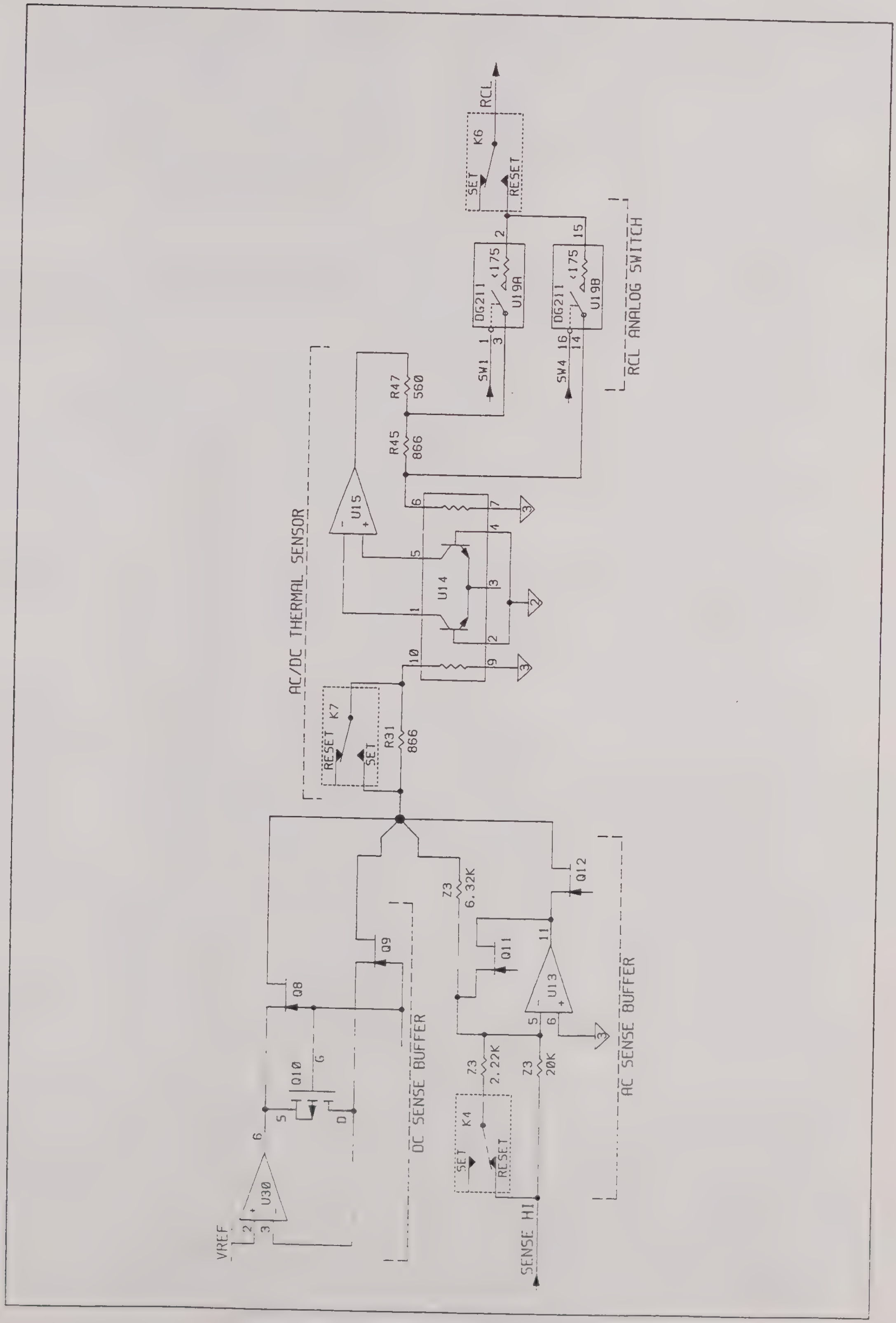


Figure 2-20. AC/DC Thermal Transfer Circuit

During operation in the 22V range, relay K4 is set, feeding the input, SENSE HI, through the 20 kΩ resistor in Z3. When operating in the 2.2V range, the 2.22 kΩ and 20.0 kΩ resistors in Z3 are put in parallel by K4 in the reset position, reducing the input resistance to 2 kΩ.

During an ac transfer, control line AC*/DC and comparator U21D turn on FET Q12 so the output of amplifier U13 is applied to the input of thermal rms sensor U14. At this time, FET Q11 is turned off and the feedback path for U13 is through the 6.32 kΩ resistor in Z3.

During a dc transfer, Q12 is off and comparator U21B turns on FET Q11, providing the feedback path for U13. Op amps U12A and U12B provide low offset and increase the gain. Control line HFCOMP and comparator U22C turn on FETs Q6 and Q7 during operation in the 1 MHz range.

The output of either the dc sense buffer or the ac sense buffer becomes the input of thermal rms sensor U14. During operation from 0.22V to 0.7V in the 2.2V range, or 2.2V to 7V in the 22V range, relay K7 is set, directly connecting the input signal to the sensor. The input to the thermal sensor is through R31 by K7 in the reset position during operation from 0.7V to 2.2V in the 2.2V range, or 7V to 22V in the 22V range.

Comparator U21A provides protection for thermal rms sensor U14. If the junction temperature of the sensor goes above 200°C, the voltage at pin 3 increases, driving the output of U21A negative. This turns off the FETs controlling the output of the dc sense buffer. The ac sense buffer gain goes to zero by turning on FET Q11.

The ac/dc thermal sensor and square-root amplifier, as outlined on the schematic, contain the thermal sensor U14, op amp U15 and transistor array U17. The dc voltage from the thermal sensor is connected to U15B configured as an integrator. Comparator U22B is used to control FETs Q18 and Q20. These FETs are turned on, adding C84 and C62 to the integrator, by control lines LFCOMP* and AC*/DC both at logic low. The output of integrator U15B is used by the square-root amplifier contained in U15A, U15C and U17. This circuit keeps the settling time of the sensor constant when its input is varied between full and 1/3 scale. The output of the sensor is connected to the RCL line by relay K6 and CMOS analog switch U19A and U19B. During operation from 0.22V to 0.7V in the 2.2V range, or 2.2V to 7V in the 22V range, sensor output is connected to the RCL line through buffer U31, U19B, and K6 in the set position. During operation from 0.7V to 2.2V in the 2.2V range, or 7V to 22V in the 22V range, sensor output is connected to the RCL line through U19A and K6. Control lines SW1 and SW4 control U19A and U19B respectively. The RCL line is routed to the DAC assembly (A11) where its amplitude is measured by the adc circuit.

To do an ac/dc transfer, the dc sense buffer is connected to the thermal sensor and the sensor output is connected to the +input of the DAC's adc circuit. The -input of the adc circuit is connected to the DAC output (VREF), and the difference between the two is measured and stored in memory. Next, the output of the ac sense buffer is connected to the sensor and the sensor output is connected to the +input of the DAC's adc circuit. The difference is measured and compared to the previous reading. The difference between these two readings is the difference in rms value of the ac and dc input voltages. If there is an ac/dc difference, the dc reference current applied to the error integrator of the analog control loop is adjusted via the 15-bit dac until the ac/dc difference is zero.

The 15-bit dac contains an AD7534 dac IC (U10), FET Q19 and op amp U26. The first 14 bits (bits 0-13) are generated by the dac IC U10, and bit 14 is generated by Q19, R26, and control line BIT14. Control busses DATA and MUX from the digital control circuit select the data and address for U10. The output is inverted by U26 to create 14 BIT DAC OUT, which is applied to the summing node of the error integrator by R20. This output is also monitored by the diagnostic circuit.

OSCILLATOR CALIBRATION 2-128.

Calibration consists of determining the offset and gain errors of the ac/dc switching circuitry. Errors are measured at dc using the calibrator DAC and the 6.5V reference as the primary sources of accuracy. This characterization is valid for frequencies up to 1 kHz. Above 1 kHz, ac/ac characterization is used to ensure the output accuracy.

The DAC assembly (A11) is set to 0V with its output connected to the ac sense buffer (via SENSE HI) by relay K1 in the set position. The output of the ac sense buffer is connected to the RCL line by K6 in the set position and by control line GCAL and comparator U22A turning on Q13. The 0V input is stored as Vin1. The output measured by the adc circuit on the DAC assembly is stored as Vout1.

Relay K1 ties 6.5V reference BRF6 and BSRF6 to VREF, where it is measured at the output of the thermal sensor in the same manner as a dc transfer. This measured output is stored in memory.

The DAC output is set to 20V or 2V and is measured at the output of the thermal sensor in the same manner as an ac transfer. The DAC is then adjusted until this measured output is the same as stored in the previous step. The DAC setting is stored as Vin2 and the 6.5V reference is Vout2. The gain can now be calculated with the formula: (Vout2 - Vout1)/(Vin2 - Vin1).

AC/DC FREQUENCY RESPONSE CHARACTERIZATION 2-129.

Characterization is accomplished by first performing an ac/dc transfer with the Oscillator Output set to a low frequency. The ac/ac thermal sensor circuit, containing the thermal sensor U16 and op amp U15D, characterizes the frequency response of the main ac/dc thermal sensor. This sensor has no active circuitry at its input, and all switching is done by relays to ensure a flat frequency response.

In the 20V range, the Oscillator Output is switched through R34 to the ac/ac thermal sensor via SENSE HI, K5, and K9 in the set position. In the 2.2V range, R34 is bypassed by K9 in the reset position. The output of this sensor is routed to the RCL line via U19C and K6. A reading is taken and stored in memory as ACref.

The output frequency of the Oscillator Output is changed to the first cal point and the 15-bit dac is adjusted until the reading from this ac/ac thermal sensor is the same as ACref.

The RCL line is then switched back to the ac/dc thermal sensor. A reading is taken stored in memory as ACdif. The gain constant is calculated using the formula (ACdif + Vdac)/Vdac, where Vdac is the DAC assembly (A11) voltage.

This ac/ac transfer function is also performed for the 220V range and the 1100V range. These ranges are generated by the Power Amplifier assembly (A16) and the High Voltage/High Current assemblies (A14 and A15). High voltage ac signals are attenuated and connected to AC CAL, where they are connected to the sensor though relay K5 in the reset position. In the 220V range, the output of the sensor is divided by Z4 and connected to the RCL line by U19D and K6.

Protection for this thermal sensor is provided by comparator U22D, FET Q14, zener diodes VR5, VR6, resistor network Z10, and diodes CR12 and CR13. During normal operation, U22D keeps Q14 off. If the junction temperature of the sensor goes above 200°C, the voltage at pin 3 increases, driving the output of U22D positive. This turns on Q14, shunting the input of the sensor to common through CR12 and CR13.

Oscillator Output Assembly (A13) 2-130.

The Oscillator Output assembly is controlled by the Oscillator Control assembly. Refer to Figure 2-21 and the schematic diagram for the following discussion.

The Oscillator Output assembly generates an ac sine wave from 0.22V to 22V with a frequency range of 10 Hz to 1.1999 MHz. There are five frequency ranges (100 Hz, 1 kHz, 10 kHz, 100 kHz and 1 MHz) and two voltage ranges (2.2V and 22V). The output signal is either routed to the OUTPUT binding posts, or it is used internally by the Power Amplifier, High Voltage, Wideband AC Module (Option -03), Current, or Switch Matrix assemblies, or it is routed to an Auxiliary Amplifier for generation of voltages and/or functions outside this range. Output sensing is available for all voltage ranges above 220 mV at the SENSE binding posts.

The Oscillator Output assembly contains a fixed-amplitude quadrature RC oscillator, a 0.22-22V digital/linear gain-controlled amplifier, a fixed-amplitude variable phase-shifting network, phase-locked loop control circuitry for phase locking to an external signal or the PLOCK signal from the Current/Hi-Res assembly (A7), and digital control circuitry.

All power supplies used by this assembly except the -12S supply are generated by the Guard Crossing/Regulator assembly (A17). The -12S supply is generated on this assembly by a three-terminal -12V regulator (U2) using the -17S supply as its input.

OSCILLATOR OUTPUT DIGITAL CONTROL 2-131.

The digital control circuit consists of an 82C55 Programmable Peripheral Interface (U26), a 5801 Latching Relay Driver (U24), and three HC374 Octal D-Type Flip Flops (U12, U32, U33). The Programmable Peripheral Interface (U26) is under software control via the guarded digital bus and has three ports which generate 24 outputs. Port A (PA0-PA7) is a common input bus for U24, U12, U32, U33, and U28. Latching relay driver U24 controls the four latching relays K1-K4. Relays K1-K3 select the frequency range and K4 selects the voltage range. This IC is strobed by PC3 of port C and enabled by PC6 of port C. To ensure that the relays are latched properly the driver must be enabled for 10 ms.

Latch U32 is clocked by PC0 and generates the data bus FREQ DATA for controlling 8-bit resolution hybrid resistive dacs U5 and U7. Latch U12 is clocked by PC1 and generates the data bus AMPL DATA for controlling U11, which is identical to U5 and U7. Latch U33 is clocked by PC2 and generates control bus PHASE, which controls multiplexer U27 in the phase shifter circuit and control bus MUX, which controls the SDL multiplexer U25 in the diagnostic circuit. This diagnostic circuit monitors the ±44S supplies, ±15S supplies, INTEGRATOR OUT, LOOP FILTER OUT, and AMP1 which is from U30, the A13A1 assembly. These voltages are divided by Z2 and Z3 and connected to the SDL line by multiplexer U25, where they are measured by the adc circuit on the DAC assembly (A11).

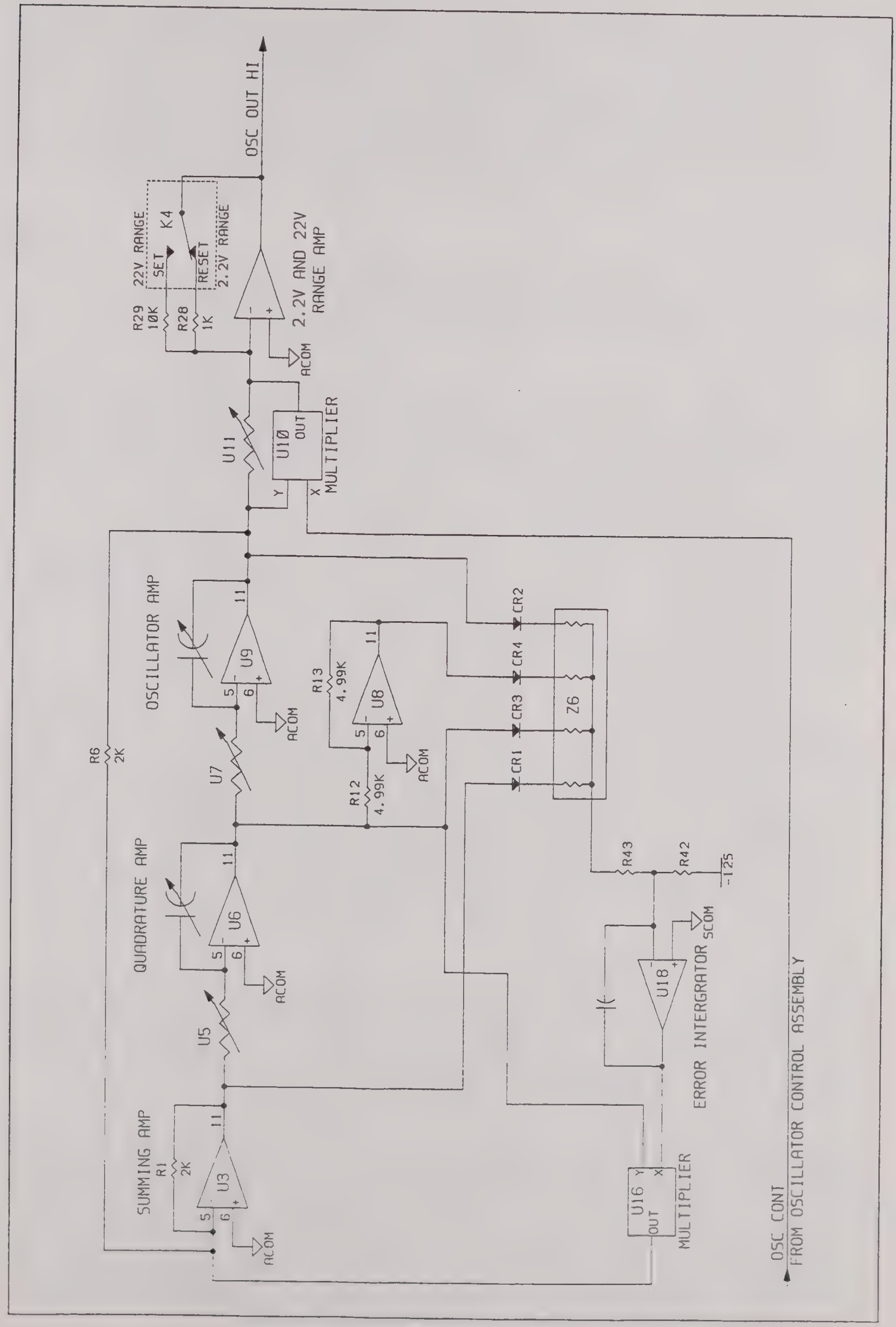


Figure 2-21. Quadrature RC Oscillator Circuit

PB0-PB2 of port B generates control bus PLOCK RNG which is used in the phase-locked loop circuit. PB4 is control line 0/180 to control FET Q7 via comparator U31B in the phase-locked loop circuit. PB6 is control line LFCOMP* to control FET Q6 via comparator U20A in the integrator circuit. PB7 is control line HFCOMP*, which is routed to the Oscillator Control assembly (A12). PC4 and PC5 are control lines DAC STRB and DAC SEL respectively, which control the dual 8-bit dac U28 in the phase shifter circuit. PC7 is control line INH to enable the multiplexer U25 in the diagnostic circuit.

QUADRATURE RC OSCILLATOR 2-132.

The quadrature oscillator is a double integrator type. It contains two op amp RC integrators and a unity-gain inverting summing amplifier. The integrators are identical and use relay-switched feedback capacitors to select five frequency ranges. An 8-bit resolution resistive dac selects frequency within a range.

The summing amplifier uses op amp U3 to provide a 180° phase shift in the oscillator loop at unity gain. Its exact phase shift and gain are adjusted by the amplitude control and phase-locked loop circuits to satisfy the conditions required for amplitude stable oscillation: exactly 360° loop-phase and unity gain. This amplitude control circuit uses an integrator and multiplier as outlined on sheet 1 of the schematic. These two circuits are described in detail later.

The two op amp RC integrators are the quadrature amplifier and the oscillator amplifier. Their purpose is to provide -90° each to the loop phase with an amplitude slope of -20dB/decade. The quadrature amplifier contains op amp U6, 8-bit resolution resistive dac U5, and relays K1B, K2B, and K3B. The relays select feedback capacitors C25, C24, C22, and C21 for frequency ranges 100 Hz, 1 kHz, 10 kHz and 100 kHz respectively. For the 1 MHz range, all the above capacitors are removed from the loop, and the only feedback path is C19. The input resistor is the 8-bit resolution resistive dac U5 which is under the control of the FREQ DATA bus from the digital control circuit. Its equivalent resistance is $R = (256/X)*2\ k\Omega$, where X is the digital code on the FREQ DATA bus. The oscillator amplifier contains op amp U9 and performs the same function as the quadrature amplifier. Its input resistance is controlled by resistive dac U7. Relays K1A, K2A, and K3A select the feedback capacitance. Since their phase shift is constant with frequency and the sum of the phase shifts around the loop is zero for all frequencies, we have satisfied one half of the requirement for oscillation. In summing the gain in dB around the loop it is apparent that unity gain occurs at only one frequency. This happens when the closed loop gains of the integrators are unity. This corresponds to $F = 1/(2 \times PI \times R \times C)$, which is the frequency of oscillation.

OSCILLATOR AMPLITUDE CONTROL 2-133.

Since small excess phase shifts exist in all three amplifiers and the gain of the summing amplifier cannot be made exactly one, it is impossible to generate an amplitude-stable sinusoidal waveform from just these elements. A control circuit consisting of an error integrator and a linear four-quadrant multiplier is used to sense the output amplitude and stabilize it by adjusting the loop phase shift slightly.

To do this, a fourth oscillator signal is generated using U8 to invert the output of the quadrature amplifier. The Oscillator now has four equal-amplitude signals all spaced 90° apart. These signals are rectified and summed by CR1-CR4 and Z6 in such a way that a dc representation of the output amplitude is created. This dc signal is summed with a -12V reference voltage by the error integrator circuit which contains op amp U18. If there is a magnitude difference between the rectified dc and the reference, the output of the error integrator changes. This in turn controls the amplitude of the oscillation. This is done via multiplier U16, a linear-variable resistance with a value inversely proportional to the error integrator output voltage.

If the control input (x input) to the multiplier is zero, the equivalent resistance from the signal input (y input) is infinite. If the control input is negative, the equivalent resistance is negative. The Y signal input of the multiplier is the quadrature amplifier output. Any nonzero control voltage changes the phase shift of the loop by injecting a small amount of out-of-phase current into the summing amplifier. This negative feedback is used to stabilize the amplitude of the oscillating signal by allowing one output amplitude only to satisfy the required conditions of oscillation. During operation in the 100 Hz range, control line LFCOMP* and comparator U20A turn off FET Q6.

PHASE-LOCKED LOOP 2-134.

The Oscillator Output assembly is phase locked to an external frequency to increase frequency accuracy. This external frequency comes from the High-Resolution Oscillator on the Current/Hi-Res assembly (A7) or from an external source connected to the rear-panel PHASE LOCK IN jack.

The frequency capture range is approximately ±5% of the nominal output frequency range. This is done by comparing the oscillator output frequency SUMMING AMP OUT or INT OSC OUT against the external frequency source P LOCK HI with a phase detector. The P LOCK HI signal is referenced to P LOCK LO. The phase-locked loop circuit locks SUMMING AMP OUT to the external frequency when the calibrator is in the 22V range or less. The phase-locked loop circuit locks INT OSC OUT, which is 180° out of phase from SUMMING AMP OUT, during calibrator operation at higher voltages. This occurs because the output from the Power Amplifier and High Voltage assemblies (which are used to generate the higher voltage ranges) are 180° out of phase from the Oscillator output. When the 5700A is in the higher voltage ranges, control line 0/180 and op amp U31B turn on Q7, which selects INT OSC OUT to the Zero Crossing Detector.

Since the phase detector circuit requires digital inputs, both signals are converted to square waves using U23A/B as dual zero crossing detectors. Square waves from the zero crossing detector circuitry are fed to the phase detector circuit containing U22A/B and U21. The phase detector circuit looks for the falling edge of both signals. The first signal that makes a positive to negative transition causes the phase detector to turn on either the positive (CR5, CR6) or the negative (CR7, CR8) charge pump, depending on which signal is first. The Charge Pump is turned off when the other signal makes its transition. Thus the signal with the highest frequency has its respective charge pump pulsed on and off while the other charge pump remains off.

The accumulated charge is integrated by the loop filter circuit, which contains op amp U31A, multiplexer U17, Z1, and C75-C84. Multiplexer U17 is controlled by the PLOCK RNG control bus from the digital control circuit. This multiplexer changes the cross-over point of the loop filter by selecting C83 and C84 for feedback in the 100 Hz range. Capacitors C81 and C82 are used for the 1 kHz range, C79 and C80 for the 10 kHz range, C77 and C78 for the 100 kHz range, and C75 and C76 for the 1 MHz range.

The output of the loop filter controls two multipliers (U15 and U19) similarly to the amplitude control section. The only difference is that the signal input is derived from the in-phase signal. In the case of U15, the input signal is QUADRATURE AMP OUT, which changes the unity-gain frequency of the oscillator amplifier. In the case of U19, the input signal is SUMMING AMP OUT, which changes the unity-gain frequency of the quadrature amplifier. The new frequency of oscillation is the new unity gain frequency of the integrators. Under phase-locked conditions, neither charge pump is allowed to turn on because neither signal reaches the phase detector first.

2.2V AND 22V RANGE OUTPUT AMPLIFIER 2-135.

The 2.2V and 22V range output amplifier is an inverting wide-band low-distortion amplifier that provides output signal OSC OUT HI at the OUTPUT binding posts in the 2.2V and 22V ranges. OSC OUT HI is used by the Power Amplifier and High Voltage assemblies to generate the higher voltage ranges.

This amplifier uses a surface-mount gain block (U30) called the Oscillator Wideband SMD PCA (A13A1) and a complementary Darlington emitter follower bootstrapped output stage. Relay K4 selects feedback resistor R28 for the 2.2V range and R29 for the 22V range. It also changes the open-loop frequency response for each voltage range. Its gain within a range is controlled by the gain control multiplier circuit and the dac gain control circuit.

The dac gain control circuit contains the same 8-bit resolution resistive dac (U11) as in the oscillator with the exception that it is controlled by the AMPL DATA control bus from the digital control circuit. This resistive DAC provides the coarse gain control. The gain control multiplier circuit contains a multiplier U10, which provides a small linear control range of several dac counts. The control input to the multiplier, OSC CONT, comes from the Oscillator Control assembly (A12). This allows the output amplitude to be adjusted as required by the Oscillator Control Assembly. The theory of operation for the rest of the output stage is described following the A13A1 theory.

Oscillator Wideband SMD Assembly (A13A1) 2-136.

The A13A1 is a surface-mount assembly on the Oscillator Output assembly (A13) that provides the 22V output signals of the 5700A. It is essentially an operational amplifier built using discrete components to provide the necessary speed, power output and breakdown voltage required for such a high output signal.

The input stage is a differential pair (Q2 and Q3) that is buffered by a source follower Q1. The transconductance is determined by R3, R4 and R26. The inherent input offset voltage of this stage is corrected by U1 and U2 and related components. The output of Q3 is level-shifted by VR5-VR7 before being applied to the mid stage. Transistor Q4 serves as a high-impedance current sink used to bias the input stage to approximately 10 mA. Potentiometer R30 adjusts the dc zero at the output of U2.

The mid stage is a common-emitter, Miller-compensated gain stage (Q5) that drives a common-base level shifter (Q13) on the Oscillator Output assembly. This stage is current limit protected by R12 and Q4. The dominant pole is set with the Miller capacitor C5 and the input stage transconductance. The mid stage is biased to 10 mA by Q6 and related components.

The output stage of the amplifier is a bootstrapped complementary Darlington pair. The only parts of the output stage on this A13A1 assembly are the input transistors Q7 and Q8. The output bias current is set by R17 and CR4-CR5 to be approximately 40 mA. This keeps the output stage class A for all normal output conditions.

OUTPUT STAGE 2-137.

The output stage circuit is a complementary Darlington emitter follower bootstrapped buffer amplifier. The input transistors are Q7 and Q8 on the A13A1 assembly. These transistors drive the output transistors Q8 and Q14 respectively. Transistors Q10 and Q11 in the positive side and Q16 and Q17 in the negative side are parallel transistors bootstrapped by VR3 and VR4. Current sources CR13, CR14, CR17, CR18, CR15, CR16, CR11, and CR20 provide the bias current for their respective bootstrapped transistors. Current limiting for the positive side is provided by Q9 and R91. During an overcurrent condition, the voltage drop across R91 turns on Q9, which draws current away from the base of Q11. Current limiting is done in the same manner for the negative side with Q15 and R99.

Switch S1 can be switched to pull the input of the A13A1 output stage low for troubleshooting the output stage. Refer to the Oscillator Output troubleshooting section for more information.

PHASE SHIFTER 2-138.

The phase shifter circuit provides a fixed amplitude variable phase auxiliary signal at the rear panel of the calibrator. This signal is the same frequency as the output, but can be phase shifted over a 360° range. The four phases (each 90° apart) for the oscillator circuit are divided by Z4 and Z5. These signals are connected to the dual four-channel multiplexer (U27), which is under the control of the PHASE control bus from the digital control circuit. This multiplexer selects any two adjacent oscillator phases (e.g. 0° and 90°) that are connected to the input of a dual monolithic DAC U28. These signals are then scaled by the dac (U28), also under the control of the digital control circuit. The two outputs of this dac are summed by op amp U29. Using this method, the output of U29 is a phase shifted signal between 0 and 360°, where the scaling of the signals phase shift within a 90° range.

Power Amplifier Assembly (A16) 2-139.

The Power Amplifier assembly outputs dc voltages from ±22V to ± 219.99999V and ac voltages from 22V to 219.99999V rms. The frequency limit for 220V ac output is 100 kHz. Output voltage limits are derated at frequencies above 100 kHz. At 1 MHz, the maximum output voltage is 22V rms. The Power Amplifier drives the High Voltage assemblies (A14, A15) in all high voltage and high current functions.

This assembly also contains calibration circuitry that enables the internal calibration system to determine exact Power Amplifier ac and dc gain, offsets and frequency response.

The main sections of this assembly are the input stage, mid stage, output stage, sense-current cancellation circuit, the dc and ac gain calibration circuits, and the Power Amplifier Digital Control SIP assembly (A16A1), which is mounted on the Power Amplifier assembly.

POWER AMPLIFIER DIGITAL CONTROL SIP ASSEMBLY (A16A1) 2-140.

Digital control for the Power Amplifier assembly is contained on the SIP assembly (A16A1) mounted at the bottom of the Power Amplifier. This assembly configures the Power Amplifier assembly for its various modes of operation. (Also see "±PA Supplies Digital Control" in the Power Amplifier Supply theory of operation.)

The heart of the Digital Control assembly is an 82C55 Programmable Peripheral Interface IC (U11) operating under software control via the guarded digital bus. This IC has three ports that generate 24 outputs. These outputs control two 5801 relay driver ICs (U10, U12), two LM339 Comparators (U13, U15) and an analog multiplexer (U14) used for diagnostics.

Relay driver U10 generates eight control lines (LC0*-LC7*) that control four latching relays (K1-K4). Relay driver U12 generates eight control lines (C0*-C7*) for non-latching relays K10-K17. C0* also controls FETs Q57 and Q58. Port A (PA0-PA7) from U11 provides an input bus common to relay drivers U10 and U12. Each driver has separate strobe and enable lines from port C of U11. Driver U10 is strobed by PC7 and enabled by PC5. Driver U12 is strobed by PC4 and enabled by PC6. When a STROBE line is selected, data on the bus (PA0-PA7) is strobed into the respective driver chip. When an ENABLE is selected, this strobed data appears at the output, thereby energizing the appropriate relays. Latching relays only need to be energized for 10 ms; non-latching relays need to be energized continuously.

As an example, the following steps are taken to set up latching relays controlled by relay driver U10.

1. Write the proper data for these relays to port A of the 82C55 (U11).
2. Write hex A to PC4-PC7 to strobe the data into U10.
3. Write hex 0 to PC4-PC7, wait 10 ms and write hex 2 to PC4-PC7. This takes U10's output out of tri-state and energizes the proper relay coils for 10 ms. Since PC4 and PC6 are always low, U12 is undisturbed.

Two LM339 quad comparators (U13 and U15) get their data from port B of U11 (PB0-PB7) and generate control lines SW0-SW7. SW0-SW2 are inputs to decoder U9, which generates eight additional control lines (CONT0*-CONT7*) for controlling FETs and solid state switches. Control line SW3 controls FETs Q50 and Q51. Control lines SW4-SW7 are routed through the motherboard to the Filter/Power Amplifier Supply assembly (A18) to control the +PA and -PA supplies.

The diagnostic circuit enables the 5700A to monitor eight diagnostic (MUX) signals on the Power Amplifier assembly. A 4051 analog multiplexer (U14) is controlled by PC0-PC3 from U11. This multiplexer selects of the eight MUX signals to the SDL line, where it is measured by the adc circuit on the DAC assembly (A11). Resistor network Z2 and various resistors and zener diodes on the Power Amplifier assembly divide these MUX signals down to a proper level for measurement by the adc circuit. The eight monitored points are:

- MUX0 Output of U7; indicates the status of the amplifier loop
- MUX1 +PA Supply
- MUX2 -PA Supply
- MUX3 Power Amplifier output
- MUX4 Indicates the temperature of the Power Amplifier assembly
- MUX5 Power Amplifier dc input
- MUX7 Diagnoses the state of the hybrid heater-control circuit

PA COMMON CIRCUITRY 2-141.

Common circuitry consists of the +PA and -PA supplies, input stage, mid stage, and the output stage. These four circuits are described under the next four headings.

Power Amplifier input node, gain, and feedback are different for dc and ac operation. Power Amplifier gain is -20 in the dc function, determined by the ratio of resistor network bonded to the HR8 assembly (500 kΩ/25 kΩ). Gain in the ac function is -10, which is determined by the ratio resistors [(R11 + R12 + R13)/R17]. This is described in more detail under "DC Voltage Function" and "AC Voltage Function".

+PA AND -PA SUPPLIES 2-142.

The ±PA supplies are high voltage supplies generated by the Filter/PA Supply assembly (A18). These supplies can be controlled by the Digital Control SIP assembly (A16A1) and are switched between the two modes shown in Table 2-13.

- ±185V
- ±365V

Theory of operation for the Filter/PA Supply assembly (A18) describes how these voltages are generated and selected.

PA INPUT STAGE 2-143.

The input stage consists of a heater-controlled hybrid HR8, op amp U7, transistor Q6, and JFET Q2. The HR8 assembly consists of an op amp mounted on a heated-substrate hybrid, with a resistor network bonded to it. Hybrid HR8 provides the input stage with excellent dc characteristics of low offset, noise and drift. The hybrid heater-control circuit (on sheet 3 of the schematic) adjusts the base voltage of Q38 to deliver the correct current to the heater resistor. This maintains the hybrid assembly at a constant temperature in spite of environmental temperature variations. Transistor Q35 protects the hybrid in case Q38 fails. Input of the hybrid op amp is protected by CR13 and CR14. Output of the hybrid op amp is connected to the input of a faster op amp (U7), which provides additional dc gain and a higher slew rate. JFET Q2 and transistor Q6 combined with these two op amps complete the input stage. Q2 is a very low-bias-current, high-frequency JFET.

In mid to high-frequency operation, Q2 is effectively the only path for the input stage signal. HR8 and the U7 op amps are bypassed at these frequencies by R89, C42, R24, and C12. As a result, the base of Q6 is at ac ground. In dc to mid-frequency operation, the gate of Q2 is at ground potential. At any frequency, the potential difference between the gate of Q2 and the base of Q6 results in a current through Q6 as determined by R22, and by the transconductance of Q2 and Q6. The input stage is called a transconductance stage because an input voltage results in a current output at the collector of Q6.

This current output is coupled to the mid stage (Q12, Q14, and Q16) by Q8, Q9, Q13 and C15, where it results in a voltage across the base-emitter of Q16 (the input of the mid stage). Current source Q9 determines bias current in Q2 and Q6. Variations of Q6 output current become voltage variations at the base of Q16. This transfer is through Q8 and Q13 at dc and low frequencies, and through C15 at high frequencies.

The input stage operates with low voltage supplies (±17V) whereas Q16 of the mid stage is connected to the -PA supply, which can be as high as -365V. This potential difference is dropped across level shifter Q13.

Table 2-13. +PA and -PA Supply Settings at Different Outputs

CALIBRATOR OUTPUT	+PA	-PA
Less than 22V ac or dc	+185V	-185V
22 to 110V dc	+185V	-185V
110 to 220V dc	+365V	-185V
-220 to -110V dc	+185V	-365V
22 to 101V ac (freq < 120 kHz)	+185V	-185V
22 to 85V ac (freq > 120 kHz)	+185V	-185V
Other voltages	+365V	-365V
220 to 550V dc or ac	+185V	-185V
550 to 1100V dc or ac	+365V	-365V
220 mA to 2.2A	+365V	-365V

PA MID STAGE 2-144.

The mid stage (Q12, Q14, and Q16), biased by the 8 mA current source (CR53, Q31, Q32 and R87 on sheet 2 of the schematic), is a voltage amplifier providing additional gain. The base of transistor Q16 is the input to the mid stage. MOSFETs Q12 and Q14 are biased by R41 and R53 respectively. Components CR21, CR23, and VR22 protect Q12 from excessive source-to-gate voltage, and R112 prevents Q12 from oscillating. Components CR25, CR29, VR28, and R113 perform the same function for Q14. A signal at the base of Q16 appears amplified at the drain of Q12. Total impedance from the drain of Q12 to ground, divided by R58, determines gain at dc and low frequencies. At high frequencies, the effective drain to ground impedance is R53. Relay K12A parallels C18 and C57 during dc operation for a lower bandwidth. Capacitors C18 and C57 provide the Miller capacitance for the amplifier.

Transconductance gain of the input stage and the Miller capacitance determine Power Amplifier frequency response at high frequencies. All the voltage gain of the Power Amplifier comes from the input and mid stages.

PA OUTPUT STAGE 2-145.

The Output Stage is an emitter follower that provides current gain but no voltage gain. It is needed because the mid stage cannot drive the rated load by itself.

Voltage across R74 and R35 determines the bias current through the output stage. This voltage equals the voltage across Q7, minus the value (4 x Vbe) (for each transistor Q4, Q5, Q10, and Q11). Transistor Q7 is configured as a Vbe multiplier, the voltage across which (and thus the output stage bias current) is the value (1 + (R23+R26)/R32). The output bias current is 50 mA.

NMOSFETs Q1, Q3, and transistor Q5 source current, while PMOSFETs Q15, Q17, and transistor Q10 sink current from the load. This output stage can drive up to 50 mA of load current as determined by the current limit circuit on ±PA supplies on the Filter/PA Supply assembly (A18).

Zener diodes VR15 and VR18 bootstrap MOSFETs Q3 and Q15 respectively, and provide the power supplies SC+ and SC- to op amp U1 in the sense current cancellation circuit. Two stacked NMOSFETs (Q1, Q3) on the top end (+PA side), and two stacked PMOSFETs (Q15, Q17) on the bottom end (-PA side) withstand the high voltage drops between ±PA supplies and output. NMOSFETs Q1 and Q3 are biased by R15 and R19 respectively. PMOSFETs Q15 and Q17 are biased by R52 and R57 respectively. Components CR5, CR7 and VR6 protect Q1 from excessive source-to-gate voltage and R108 prevents Q1 from oscillating. Protection is also provided for remaining MOSFETs in the output stage. Output of this stage, called PA OUT HI, is the output of the Power Amplifier assembly. Components R120 and L10 isolate capacitive loads.

PA SENSE CURRENT CANCELLATION CIRCUITRY 2-146.

During dc operation of the Power Amplifier, sense current in the 500 kΩ feedback resistor (on the resistor network in the HR8 assembly) can cause an output error because of the finite resistance path of the connection to the load. Op amp U1 eliminates this error by feeding an equal and opposite current in this path. The magnitude of this current is determined by PA OUT HI, which is connected to the non-inverting input of U1. This circuit generates a current through R8, which is equal to current flowing through the 500 kΩ feedback resistor. Sense-current cancellation is active only in dc 220V range.

PA IN STANDBY 2-147.

The Power Amplifier schematic shows all relays and DG211 FET switches in the standby condition. The Power Amplifier 25 kΩ input resistor and R17 are tied to OS COM through Q39 and R118. Power Amplifier output is close to zero and the whole loop is stabilized.

To better understand Power Amplifier configuration in the ac/dc 220V range, refer to Figure 2-22.

PA OPERATION: 220V DC RANGE 2-148.

During dc operation, Power Amplifier gain is -20, as determined by the 500 kΩ/25 kΩ resistor network on the HR8 assembly. Control line SW3, inverted by U8, turns on Q51. This references the +input of the precision op amp in the input stage to R COM. The DAC assembly is set to the negative 11V range and its outputs, DAC OUT HI and DAC SENSE HI, are connected to pin 2 of the resistor network on the HR8 assembly by relay K2. The sense current cancellation circuit is active during dc operation. Its output, SIG1, is connected to the resistor network feedback resistor pin 1 by relay K15A. The amplifier has a much lower bandwidth in this mode because of the much higher Miller capacitance in C57. Lower bandwidth results in lower amplifier noise.

The output signal, PA OUT HI, is routed to the High Voltage Control assembly (A14), where it goes through relay K10 and becomes PA OUT DC. PA OUT DC is routed to the Switch Matrix for connection to the OUTPUT HI binding post. The sense signal, PA SENSE DC from the Sense Current Cancellation circuit, is routed to the Switch Matrix assembly (A8) for connection to the OUT/SENSE HI or SENSE HI binding posts, thus making the binding post the sense point in internal sense and allowing for external sense through the SENSE HI binding post.

PA OPERATION: 220V AC RANGE 2-149.

During ac operation, Power Amplifier gain is -10 as determined by the 4.99 kΩ input resistor R17, and 49.9 kΩ feedback resistors (R11 + R12 + R13). Control line SW3 turns Q50 on, which references the +input of the precision op amp in the input stage to OS COM. The Oscillator assembly (A13) is set to the 22V range and its output OSC OUT HI is connected to the input resistor R17 by relay K10A. The Power Amplifier output is connected to the feedback resistors R11-R13 by relay K12B.

The Power Amplifier output is attenuated by a precise 1/100 by 220V range ac attenuator. The attenuated signal is connected to OSC SENSE HI, where it is sent to the Oscillator Control assembly (A12). The Oscillator Control assembly regulates the Oscillator Output so that an exact calibrated ac signal appears at OSC SENSE HI. Since the 220V range ac attenuator is completely characterized (as explained below), the exact desired signal appears at PA SENSE AC and hence at the appropriate sense point at the output.

The 220V range ac attenuator circuit contains op amp U4, a 400 kΩ/4 kΩ resistor network Z1, and transistor Q54. PA SENSE AC, which is connected to PA OUT HI at the load, is connected to the 400 kΩ input resistor (pin 1) of Z1 by relay K16. The 400 kΩ/4 kΩ node (pin 3) of Z1 is connected to the inverting input of U4.

During ac operation, control line C0* is inverted by U8, which turns on Q58 to connect the non-inverting input to OSC RCOM. Transistor Q54 supplies current gain for the output of U4 to drive the capacitance of the OSC SENSE HI line. This voltage is connected to the 4 kΩ feedback resistor (pin 4) of Z1. The output is connected to OSC SENSE HI by relays K10B and K11. The dc feedback 500 kΩ/25 kΩ resistor network and the sense-current cancellation circuitry are disconnected by energizing K15.

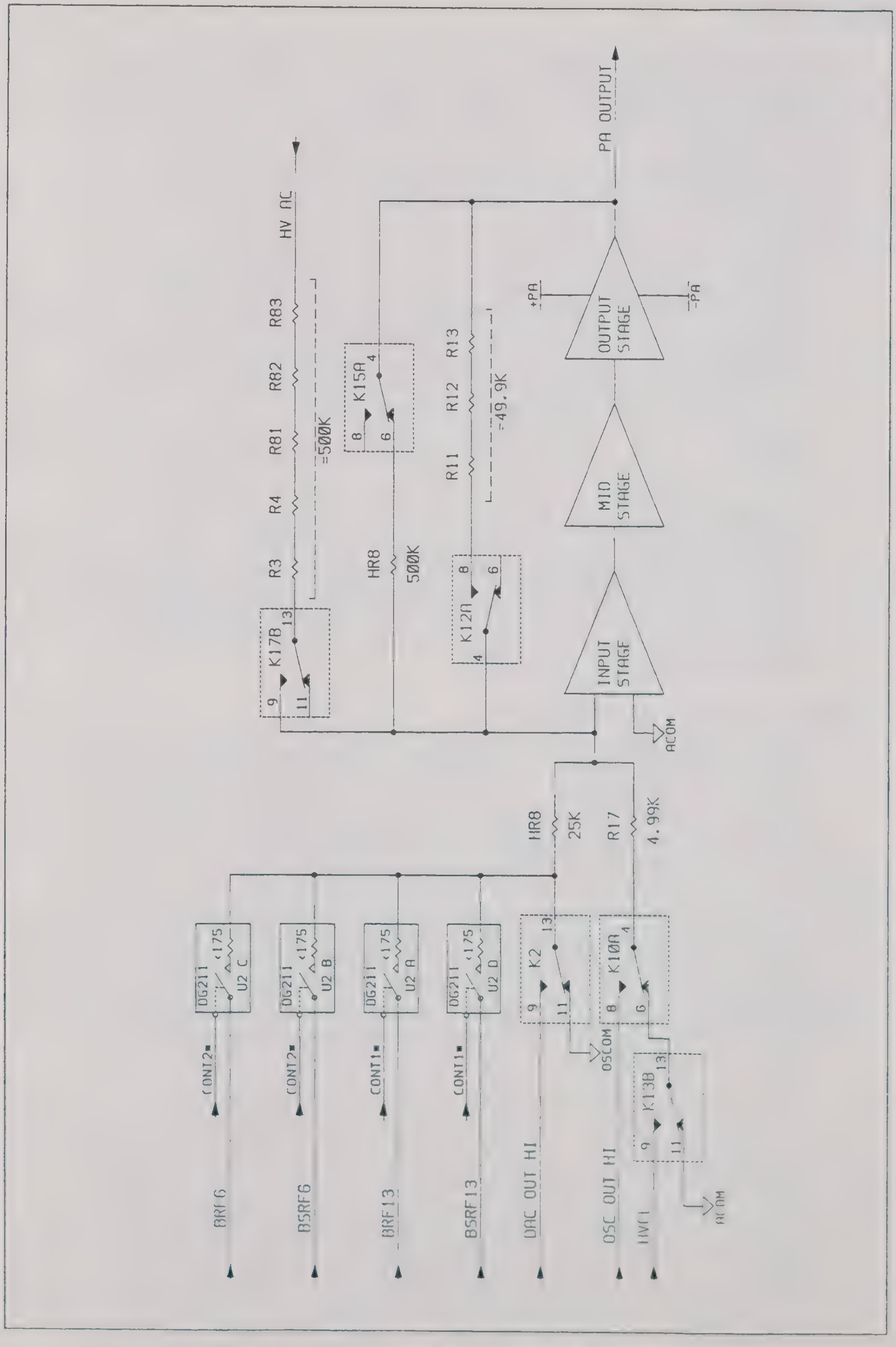


Figure 2-22. Power Amplifier Simplified Schematic

The sense signal, PA SENSE AC, and the output signal, PA OUT HI, are routed to the High Voltage Control assembly (A14), where relays K10, K13, and K3 connect them to HV SENSE and HV OUT. HV SENSE and HV OUT are connected to the binding posts by the motherboard relays in the same manner as in the 1100V high voltage mode. Refer to the High Voltage assembly theory of operation for more information.

HIGH VOLTAGE ASSEMBLY SUPPORT MODE 2-150.

High Voltage AC 1100V Range 2-151.

During high voltage ac operation, the output of the Power Amplifier is routed to the input of a step up/down transformer on the High Voltage Control assembly (A14). Overall gain from the Oscillator Output to the High Voltage Output is -100 as determined by the 4.99 kΩ input resistor R17, and 500 kΩ feedback resistor (R3 + R4 + R81 + R82 + R83). Relay K10A connects the ac signal OSC OUT HI from the Oscillator Output assembly to input resistor R17. Relay K12 remains open as shown on the schematic, while K15 is energized to remove feedback used in 220V-dc operation.

Output from the High Voltage Control assembly, called HVAC on the schematic, is connected to the feedback resistors. Relay K17B is energized to close the feedback loop. Control line SW3 is high, which turns Q50 on and turns Q51 off. Because sensing back to the Oscillator Control assembly is done by the High Voltage/High Current assembly, the output of the 220V range ac attenuator is disabled from OSC SENSE HI by relay K11.

High Voltage DC 1100V Range and Current 2.2A Range 2-152.

Operation of the Power Amplifier is the same for the 1100V dc and the 2.2A current functions. In these functions, the output of the Power Amplifier is routed to a step up/down transformer on the High Voltage Control assembly (A14). The Power Amplifier is configured the same as for 220V ac operation, except that the input is the square-wave signal HVCL from the High Voltage Control assembly, rather than OSC OUT HI, through relays K13B and K10A.

220V DC INTERNAL CALIBRATION NETWORK 2-153.

The 220V dc internal calibration network determines the exact gains and offsets of the power amplifier. This circuit uses part of the resistor network HR8 as the input attenuator, and uses op amp U9, and zener diodes VR57 and VR58. Relay K4 connects the output of this circuit to the RCL line.

Zener diodes VR57 and VR58 reduce the power supplies for chopper-stabilized amplifier U9, which is used as a voltage follower.

PA CALIBRATION 2-154.

The following paragraphs describe how the Power Amplifier assembly is calibrated during the internal portion of calibration, or calibration check. This process calibrate the offset, gain, and frequency characteristics of the Power Amplifier.

The instrument measures the offset of the main amplifier (220V range). The DAC output is amplified by the Power Amplifier, which is configured for the dc 220V range, and its output connected to the internal cal zero amplifier located on the Switch Matrix assembly. Output of this internal cal zero amplifier is channeled to the DAC's adc amplifier circuit by the RCL line. Input of the internal cal zero amplifier is first connected to R COM where a checkpoint reading is taken by the DAC's adc circuit. The output of the Power Amplifier is then connected to the input of the internal cal zero amplifier and the DAC output is adjusted to the checkpoint reading out of the zero amplifier. This adjusted DAC output is a measure of the offset of the Power Amplifier. Also, refer to the Switch Matrix theory of operation.

The 175 kΩ/25 kΩ (internal cal) resistor network located on HR8 is calibrated next (see Figure 2-23). First the offset of the 220V dc internal cal amplifier is measured. This is done by connecting pin 6 of 175 kΩ/25 kΩ resistor network to RCOM by relay K1, and pin 7 to ACOM by U5C and relay K3. ACOM is connected to RCOM through 051 during this step. Output of this internal cal amplifier is connected to the RCL line by relay K4, where it is measured by the adc circuit on the DAC assembly. As before, the DAC's output needed to obtain the checkpoint for this step represents the offset of the internal calibration amplifier.

Resistor network attenuation is calibrated next. Components U5A, U5D and K3 connect BSRF13 and BRF13 to the 175 kΩ end, while K1 connects R COM to the 25 kΩ end of the resistor network. The resulting 1.625V at the output is connected to the RCL line by relay K4, where it is connected to the +input of the adc amplifier circuit on the DAC assembly. The DAC output is connected to the adc circuit -input, and adjusted until the checkpoint reading is obtained. The exact value of this voltage is now known, so the system software computes the exact attenuator ratio from this known voltage, BSRF13 value, and the previous offset measurement.

Power Amplifier dc gain of approximately -20 is calibrated next. The Power Amplifier is configured as in the 220V dc operation, except the input is connected to the DAC's 6.5V reference BRF6 and BSRF6 by U2C and U2D respectively. The resulting -130V at the Power Amplifier output is connected to the 175 kΩ end of the internal cal resistor network by relay K3. The 25 kΩ end of this network is connected to DAC OUT HI and DAC SENSE HI by relay K1. The output of the internal cal amplifier is connected to the DAC's adc circuit as in the previous steps, and the DAC OUTPUT is adjusted until checkpoint is measured by the adc circuit. Since the exact attenuation of the resistor networks is already known, the exact Power Amplifier output voltage can be calculated. This in turn gives the exact Power Amplifier dc gain, since the exact value of 6.5V reference BSRF6 is known.

Attenuation of the 220V range ac attenuator (U4 and 396 kΩ/4 kΩ resistor network Z1) is calibrated next. This is illustrated in Figure 2-24. First, the offset of the attenuator circuit is measured by connecting the non-inverting input of U4 to ACOM through Q57 and thus to RCOM through Q51. Then, the Power Amplifier is configured for the 220V dc range with its inputs connected to the DAC's 6.5V reference BRF6 and BSRF6 by U2B and U2C respectively. The resulting -130V is connected to the 400 kΩ input resistor (Z1) of the 220V range ac attenuator by relay K16.

The +1.3V from the output of the attenuator circuit is connected to the RCL line by relays K10B and K11. This voltage on the RCL line is connected to the +input of the adc amplifier circuit on the DAC assembly. The DAC output is connected to the -input of the adc amplifier circuit, and is adjusted until a null is achieved. The exact value of this voltage is now known so the system software can compute the exact attenuator ratio.

The 220V range ac attenuator's attenuation ratio can vary over the frequency range. This variation can be accounted for if the frequency response of this network is characterized at a few spot frequencies. This is done by connecting the Power Amplifier output, which is set to 22V, to the AC CAL line by relay K14. The AC CAL line goes into the AC/AC CAL thermal sensor located on the Oscillator Control assembly. The Power Amplifier output of 22V is also attenuated through the AC Attenuator and sensed by the Oscillator Control via OSC SENSE HI. The Oscillator adjusts its output, and hence the Power Amplifier output, until the ac/ac cal thermal sensor measures the same ac level for all these spot frequencies. The signal levels at OSC SENSE HI are stored in software at all such points.

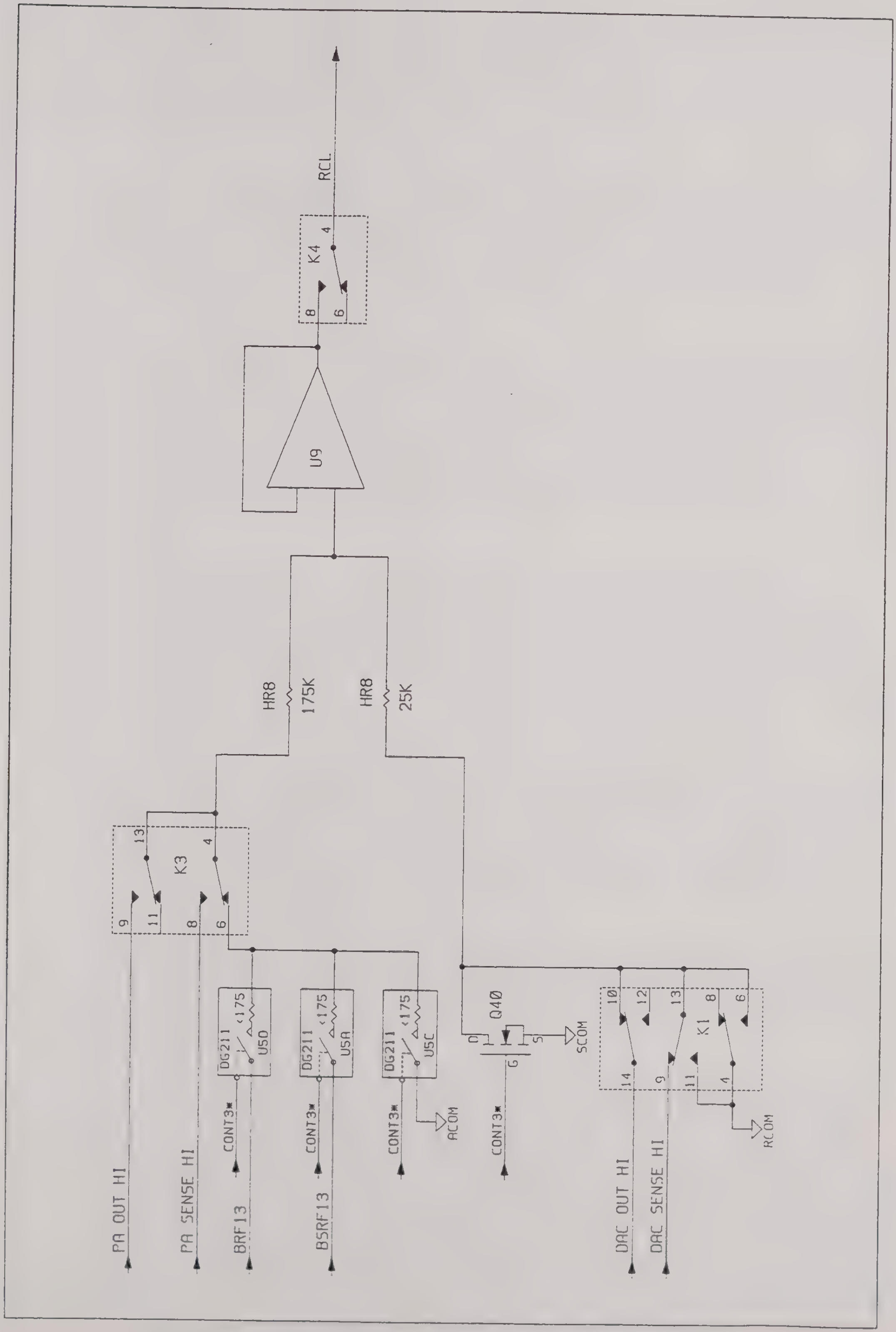


Figure 2-23. Power Amplifier DC Calibration Network

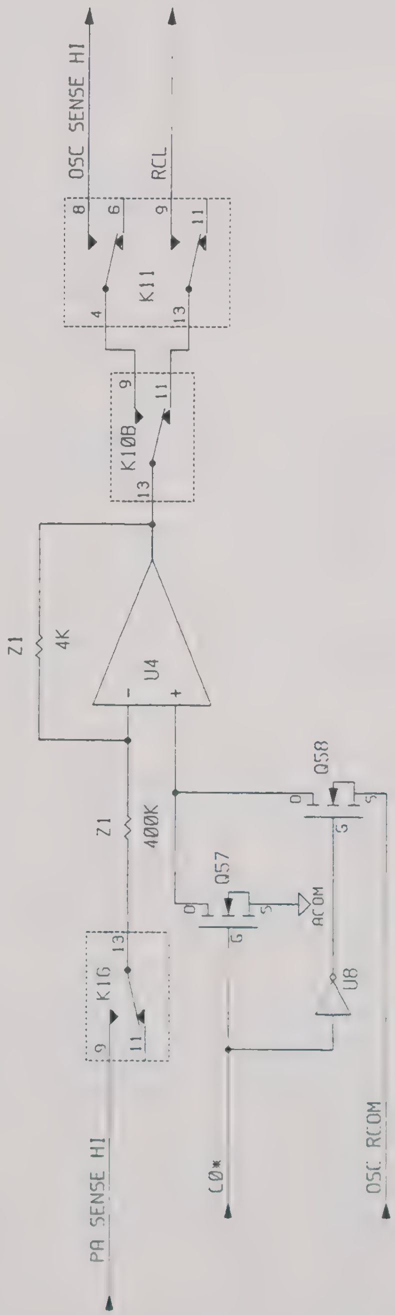


Figure 2-24. Power Amplifier Calibration AC Attenuator

The ac/ac cal thermal sensor located on the Oscillator Control assembly has a flat frequency response. The change in the ac attenuator's output at various frequencies for a constant thermal sensor output defines the frequency response of the Power Amplifier ac attenuator. These computed ac attenuator factors are stored in the system memory and are taken into account when the calibrator is configured to output ac voltages from the Power Amplifier.

Output stage current is limited to about 250 mA; Q60 limits the current sourced by the output stage, and Q61 limits the current the output stage has to sink. Transistor Q62 limits the current flowing through the middle stage. These current limits both protect the power amplifier circuitry and improve power amplifier transient response. Diode CR64 is a current source that maintains a current flow of at least 5 mA through the output devices at all times.

High Voltage Assemblies (A14 and A15) 2-155.

The High Voltage/High Current assembly (A15) and the High Voltage Control assembly (A14) are used in with conjunction with other assemblies in the calibrator to generate the ±1100V dc, 1100V ac, and the 2.2A ranges. The two assemblies work together in generating these ranges. This theory of operation explains how these ranges are generated and discusses the individual circuits on each assembly. Refer to the High Voltage/High Current assembly simplified schematics (Figures 2-24 through 2-28) or the schematic diagram to understand this theory of operation better.

1100V AC RANGE 2-156.

Refer to Figure 2-25 for the following discussion. The ac signal generated by the Oscillator Output assembly (A13) is amplified by the Power Amplifier assembly (A16). The output of the Power Amplifier, PA OUT DC, is routed to the High Voltage Control assembly (A14), where it is further amplified by transformer T1 to generate the 1100V ac range. This high voltage signal from T1 is also the feedback signal to the Power Amplifier assembly. Relays K14-K16 connect the transformer windings in series during operation below 120 Hz.

Line PA OUT DC is connected to one side of the primary winding of step-up transformer T1 by relay K1 on the High Voltage Control assembly (A14). The other side of the primary winding is tied to PA COM through R67. One side of the secondary winding is tied to PA COM by relays K9 and K6. The other side of the secondary winding, the high voltage ac signal, is connected to HV OUT by relays K5, K12 and K3. Line HV OUT is connected to the OUTPUT HI binding post by relays K9 and K1 on the motherboard.

This high voltage ac signal is also connected to HVAC by relay K5. Line HVAC is the feedback signal to the Power Amplifier assembly. During high voltage operation, the input resistance of the Power Amplifier assembly is 5 kΩ. Line HVAC is connected to the feedback resistance, which is a series of resistors totaling 500 kΩ. This creates a gain of 100 to the Oscillator Output.

The SENSE HI binding post is connected to HV SENSE by relays K3, K2, and K10 on the motherboard. HV SENSE, which is tied to HV OUT at the load, is connected to INT HV SNS by relay K13 on the High Voltage Control assembly (A14). INT HV SNS is routed to the High Voltage/High Current assembly (A15), where it is connected to the ac sense buffer circuit by relay K6. This circuit attenuates the high voltage signal by 100 and connects it to OSC SENSE HI through relay K4B. The level of attenuation is determined by the 7 MΩ input and 70 kΩ feedback resistors on the HR7 assembly. OSC SENSE HI is used by the Oscillator Output assembly, which adjusts its output signal to maintain an exact feedback signal level. HV OUT and HV SENSE are routed to the High Voltage assembly (A15) where components CR9, CR10, and R33-R35 keep the voltage difference between them at 0.7V should they become disconnected at the load. Relay K11 connects HV OUT to HV SENSE during calibration in the ac function.

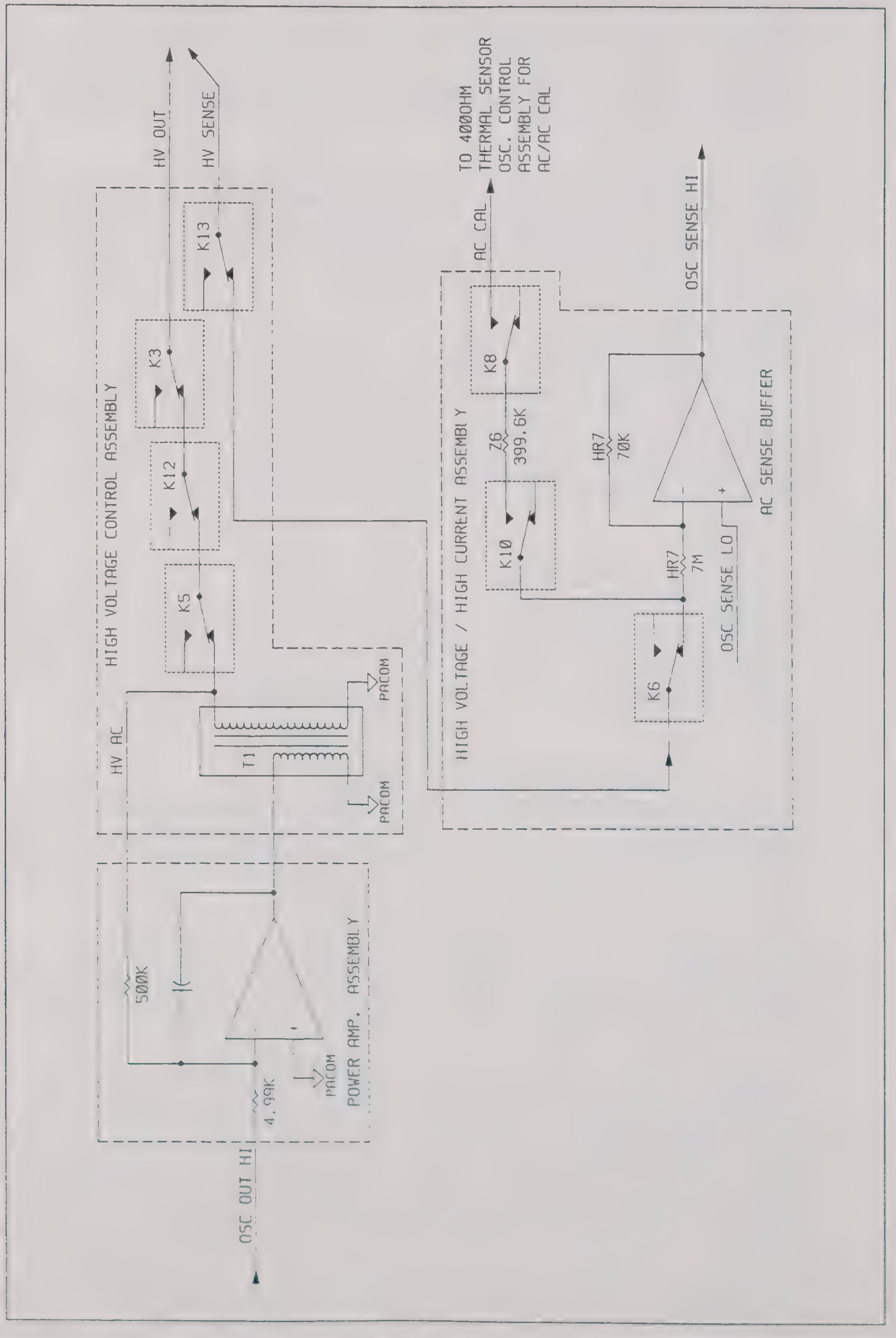


Figure 2-25. High Voltage/High Current Assembly 1100V AC Range

1100V DC RANGE 2-157.

Refer to Figure 2-26 for the following discussion. The High Voltage assembly (A15) amplifies the output of the DAC assembly (A11), set to the 11V range, by a gain of -100 to generate the 1100V dc range.

For operation in the 1100V dc range, DAC OUT HI and DAC SENSE HI from the DAC assembly, set to the 11V range, are tied together and connected to the input of the dc HV amplifier circuit by relay K1. The dc HV amplifier circuit, the HV dc output series pass and current limit circuit, and the HV dc power supply circuit on the High Voltage Control assembly (A14) constitute an overall amplifier with an inverting gain of 100. This gain is determined by the 70 kΩ input and 7 MΩ feedback resistors on the HR7 assembly.

High voltage dc output, generated on the High Voltage Control assembly (A14), is obtained by filtering an approximate trapezoidal wave. The overall loop gain of this amplifier divides this ripple so the high voltage dc output is clean and stable.

Signal routing to the front panel binding posts is done in the same manner as the ac 1100V range.

HVDC POWER SUPPLY FILTER CIRCUIT 2-158.

The high voltage dc power supplies are generated by the High Voltage Control assembly (A14) in conjunction with the Power Amplifier assembly (A16). The High Voltage Control assembly generates an amplitude-controlled square wave, HVCL, from the magnitude control circuitry. The magnitude control circuit contains all the circuitry on sheet 2 of the High Voltage Control assembly schematic.

Signal HVCL is amplified by the Power Amplifier assembly with its output, PA OUT DC, connected to one side of the primary winding of transformer T1 by relay K1. The other side of the primary is connected to PA COM by R67. The secondary windings of T1 are connected to bridge rectifier CR1-CR4 by relays K9 and K6. The dc voltage from this rectifier is called +HVDC and -HVDC. Resistors R3-R5 form a 600 kΩ bleeder resistor for C1. Line HVDC is selected between +HVDC and -HVDC by relays K4 and K11. Line HVDC is connected to HV OUT by relays K5, K12 and K3.

During operation with a negative DAC voltage and a positive output from the High Voltage/High Current assembly, +HVDC is connected to HV OUT by relays K4, K11, K5, K12 and K3. +SP C is created from -HVDC by relays K4 and K8. During operation with a positive DAC voltage and a negative output from the High Voltage/High Current assembly, -HVDC is connected to HV OUT by relays K4, K11, K5, K12 and K3. -SP C is created from +HVDC by relays K4 and K8. Zener diodes VR4 and VR5 keep -SP C and +SP C, respectively, from exceeding 16V. The dc voltage level of +SP C and -SP C is controlled by the HV dc output series pass and current limit circuit on the High Voltage/High Current assembly. This in turn controls the magnitude of HVCL which sets the level of HVDC.

HV DC OUTPUT SERIES PASS AND CURRENT LIMIT CIRCUIT 2-159.

The HV dc output series pass circuit controls the level of +SP C when the high voltage output is positive, and -SP C when the high voltage output is negative. Typically +SP C and -SP C are approximately ±6.8V dc with ripple equal and opposite polarity from the HVDC ripple.

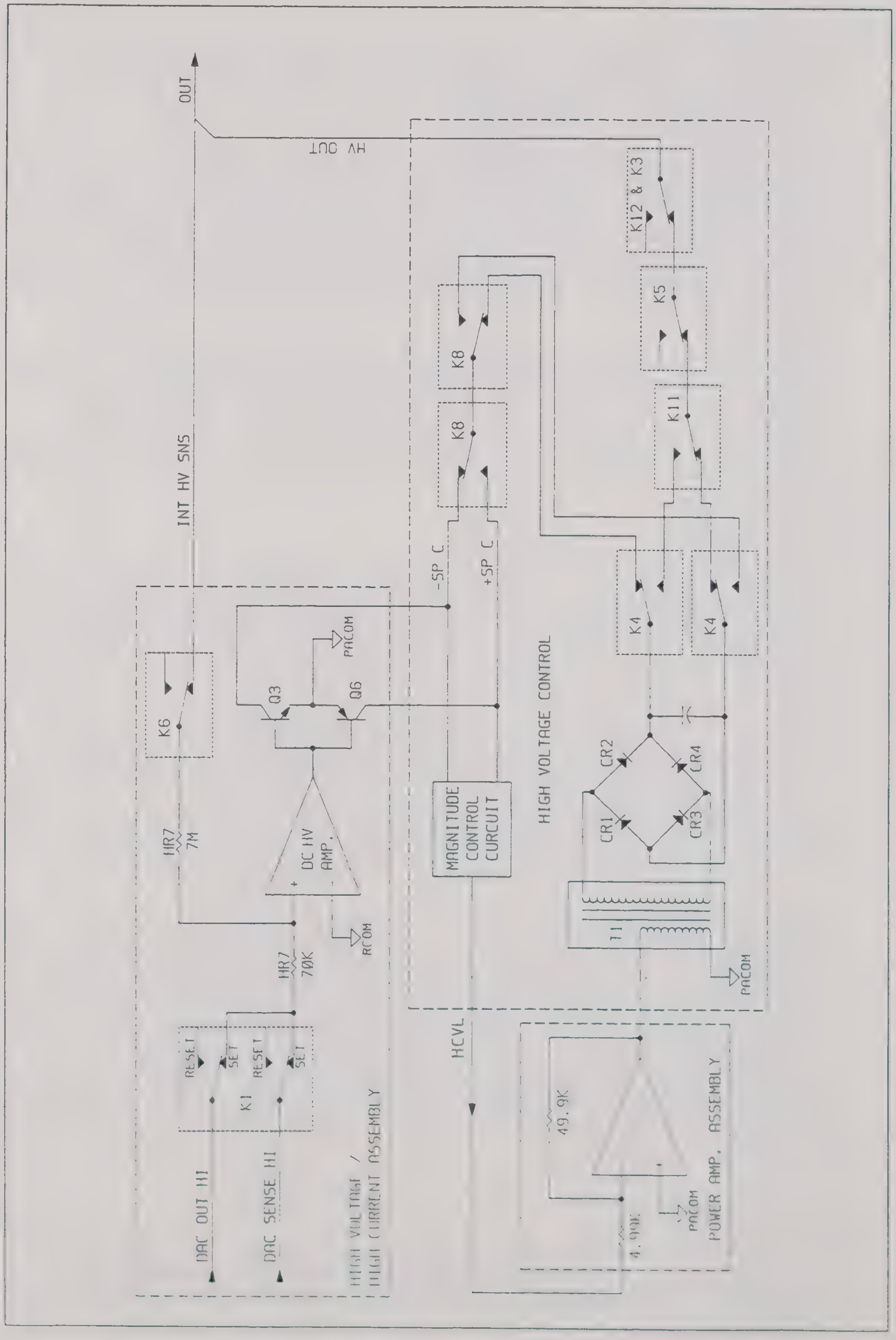


Figure 2-26. High Voltage/High Current Assembly 1100V DC Range

When the DAC assembly is set to the +11V range, the output from the High Voltage assembly (with a gain of -100) is in the -1100V range. In this mode, -SP C is connected to the collector of transistor Q3. The output from the dc HV amplifier follows a change in the output voltage from the DAC assembly. This change controls how much Q3 is turned on or off. As the DAC voltage is increased, Q3 turns on pulling -SP C to PACOM. This causes the magnitude control circuit to increase the amplitude of HVCL which increases the output from the Power Amplifier assembly, thus increasing the HVDC until the overall loop is stable.

Operation in the +1100V range is basically the same, with transistor Q6 controlling +SP C in the same manner as above.

Current limiting is provided by Q4 if more than 35 mA is drawn from the output. If this condition occurs, Q4 pulls down CUR LIM, which is routed to the High Voltage Control assembly. (CUR LIM is also called RST.) When CUR LIM (RST) is pulled low, PS OFF goes high to turn off the square wave, HVCL, which shuts down the HVDC supplies. The generation of HVCL is described under the heading, “Magnitude Control”.

DC HV AMPLIFIER/AC SENSE BUFFER 2-160.

The dc HV amplifier and the ac sense buffer are basically the same circuit. The configuration is changed to provide the 100:1 amplification of dc voltage and the 100:1 attenuation of the high voltage ac signal. This is defined by the way the HR7 resistor network is configured in the circuit. This configuration is described in the 1100V ac range and 1100V dc range theory.

This circuit contains the HR7 resistor network and the circuitry contained in detail 1 as shown on sheet 1 of the High Voltage (A15) schematic. It is used in both the ac and dc voltage modes. Detail 1 contains the HR7 hybrid assembly which is an op amp mounted on a heated substrate hybrid bonded to a resistor network. The HR7 assembly gives this circuit excellent dc characteristics of low offset, noise and drift. The hybrid heater control circuit adjusts the base voltage of Q8 to deliver the proper power to the heater resistor. This maintains the HR7 assembly at a constant temperature in spite of environmental temperature variations. Transistor Q9 protects the hybrid in case Q8 fails. The output of the HR7 op amp is connected to a faster op amp (U2), which provides additional gain and a high slew rate. The output of U2 is called HVAMP OUT on the schematic.

In the dc voltage function, the output of this circuit, configured as a dc HV amplifier, is connected to the series pass circuit by relay K5B. Relays K5A, K7 and K14 add C4 in parallel with the 7 MΩ feedback resistor in the HR7 assembly to filter the noise. ACOM is connected to RCOM by relay K3.

During operation in the ac voltage function relays are positioned as shown on the schematic. Components VR7 and VR8 provide input protection for the op amp on the HR7 assembly. Op amp U1 is added to the circuit by relays K9, K8B and K6. This op amp inverts HVAMP OUT so that the signal to OSC SENSE HI is in phase with the output of the Oscillator assembly. ACOM is connected to OSC RCOM by relays K3 and K4A.

2.2A RANGE 2-161.

Refer to Figure 2-27 for the following discussion. Most of the same circuitry is used to create the ac and dc 2.2A current ranges. The Current assembly (A7) is configured to the 22 mA range and connected to the IHV line which drives the 2.2A amplifier circuit on the High Voltage assembly (A15). This 2.2A amplifier provides a gain of 100 to the 22 mA range from the Current assembly to create the 2.2A range.

Resistor network Z5 and hybrid H4 determine the performance of the 2.2A range. Current from the A7 assembly develops a voltage across the 57Ω portion of Z5. The 2.2A current amplifier circuit forces the same voltage across the 0.57Ω portion of Z5. Because the ratio of these resistors is 100, the current through 0.57Ω resistor is 100 times that coming from the Current assembly (A7). Relay K12 connects this 2.2A range current to B CUR where it is routed to the Current assembly (A7), which provides the proper relay switching to the front panel binding posts.

The 2.2A amplifier circuit contains the heater-controlled hybrid H4, op amps U3-U5, and transistors Q11-Q16. This circuitry is outlined as detail 2 on sheet 2 of the High Voltage/High Current assembly schematic. The H4 hybrid consists of an op amp mounted on a heated substrate. The heater control circuit adjusts the base voltage of Q18 to deliver the proper power to the heater resistor. This maintains the hybrid at a constant temperature in spite of environmental temperature variations. Transistor Q19 protects the hybrid in case Q18 fails.

The output of the H4 hybrid is a voltage directly proportional to the current output G OUT. Q22 and R72-R76 form a high-frequency path for loop stability. In the ac current function, op amp U3A and its associated circuitry create a half-wave signal equal to the positive peaks of the ac signal from H4. Resistor R47 keeps this half-wave signal approximately 0.7V above 0V. This half-wave signal is then subtracted from the ac signal coming from H4 by op amp U3B and its associated circuitry. This creates a half-wave signal equal to the negative peaks of the ac signal from H4. Resistor R45 keeps this half-wave signal approximately 0.7V below 0V. Transistor Q15 and resistor R50 generate a current from the negative peaks created by U3B. Transistor Q16 and R48 generate a current from the positive peaks created from U3A. The current from Q15 and R50 develops a voltage across the 191Ω resistor (R69). This voltage is used by op amp U4 which drives transistors Q11 and Q12 in the Darlington configuration for current gain. Resistor R67 is the feedback path for U4. The voltage across 191Ω resistor R69 is the same as across the 0.1Ω resistors R68 and R78. Since the value of R68 and R78 is 1000 times less than R69, the current through R68 is 1000 times greater. The current from Q16 and R48 is increased by 1000, in the same manner as previously stated, with op amp U5, resistors R56, R57, and R77, and Darlington-configured transistors Q13 and Q14.

Only half of the circuitry is used, since the output current is either positive or negative in the dc current function. When outputting a positive current, the voltage from H4 is negative. Since there is no positive voltage, the output of U3A is zero, thus no current is developed by R48 and Q16. At this time, the negative voltage from U3B generates an output current in the same manner as in the ac current function. The opposite occurs when outputting a negative dc current.

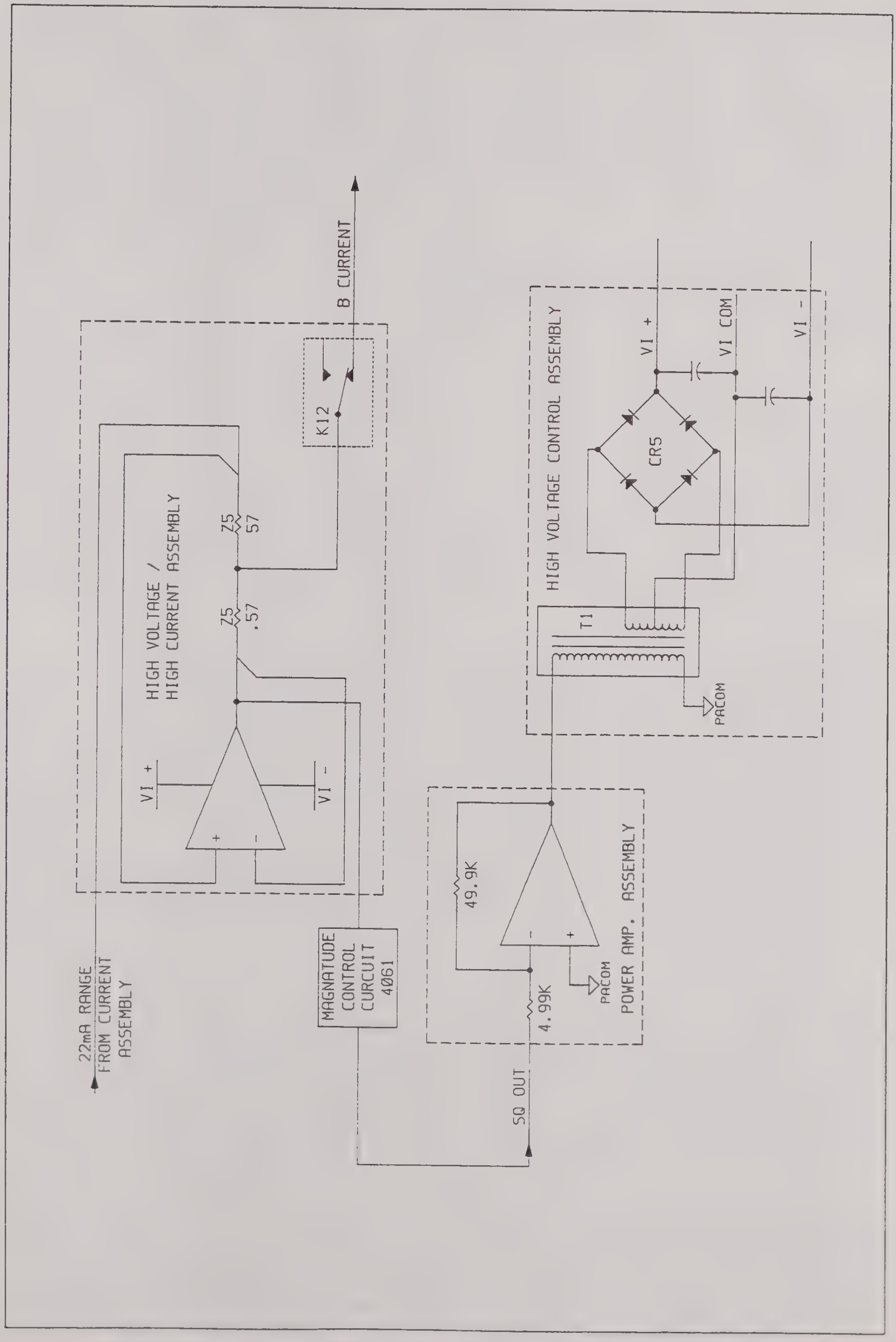


Figure 2-27. High Voltage/High Current Assembly 2.2A AC and DC Ranges

2.2A POWER SUPPLY FILTER CIRCUIT 2-162.

The 2A range power supply filter circuit on the High Voltage Control assembly (A14), operating in conjunction with the Power Amplifier assembly (A16), generates the VI ±supplies used by the 2.2A amplifier circuit on the High Voltage/High Current assembly (A15). The High Voltage Control assembly generates an amplitude controlled square wave, HVCL, from the square wave generator and square wave amplifier circuits. This HVCL is amplified by the Power Amplifier assembly (A16), which is set for a gain of 10. This amplified output, PA OUT DC, is connected to the primary side of transformer T1 by relay K1. The stepped-down secondary voltage is full-wave rectified by CR5 and filtered by C3 and C4 to generate the VI+ and VI- supplies respectively. VI± are low-voltage, high current supplies. These supplies, along with the secondary center tap VI COM, are routed to the High Voltage assembly.

VI+ supplies the output current when sourcing while VI- sinks it. To minimize power dissipation, the magnitude of the VI± supplies is controlled to minimize the emitter to collector voltage on the output stage transistors (Q11, Q14). This is done by controlling the magnitude of the HVCL signal. The controlling function is described later in the Magnitude Control theory.

HIGH VOLTAGE DIGITAL CONTROL 2-163.

Digital control circuitry on the High Voltage Control assembly (A14) also contains the control for the High Voltage/High Current assembly (A15). The heart of the digital control circuitry is an 82C55 Programmable Peripheral Interface IC (U9), which is under software control via the guarded digital bus. This IC has three ports which generate 24 outputs. These outputs are used to control four 5801 driver ICs (U10-U13), and an analog multiplexer (U14) for self diagnostics.

All relays on both HV assemblies are controlled by drivers U10, U11, U12, and U13. Driver U12 controls relays K14-K16, and generates seven control lines for controlling various FETs and CMOS Analog Switch ICs contained on both assemblies. Port A (PA0-PA7) of U9 provides a common input bus for all drivers. Port C (PC0-PC5) of U9 provides the strobe and enable lines for these drivers. Driver U10, which controls the non-latching relays (K1-K6, K8-K13) on the High Voltage Control assembly, is strobed by PC1. PC0 is inverted by U8C to provide the enable. Driver U11 controls latching relay K7 on the High Voltage Control assembly and latching relays K1-K3 on the High Voltage/High Current assembly. This driver is strobed by PC3. PC2 is inverted by U8D to provide the enable. Driver U13, which controls the non-latching relays on the High Voltage/High Current assembly (K4-K12 and K14), is strobed by PC5 and enabled in the same manner as U10. Driver U12, which generates the Control Lines, is strobed by PC4 and enabled in the same manner as U10. Control line RST, from this driver, is inverted by U8E to create PS OFF. This control line is used by the magnitude control circuit described later.

The diagnostic circuit enables the 5700A to monitor seven points on either the High Voltage/High Current assembly (A15) or the High Voltage Control assembly (A14). A 4051 analog multiplexer (U14) is controlled by PB4-PB7 of port B of U9. This multiplexer selects which one of these seven voltages are to be applied to the SDL line where it is measured by the adc circuit on the DAC assembly (A11). HV MUX0-HV MUX3 are points on the High Voltage/High Current assembly. HV MUX0 and HV MUX1 monitor the oven temperature of the H4 and HR7 hybrids respectively. The output of the dc HV amplifier/ac sense buffer circuit is divided by R18 and R19 to generate HV MUX2. HV MUX3 monitors the current draw through the HV dc output series pass circuit to detect an overcurrent condition in the high voltage dc mode. Resistors R28 and R27 sense the current for a positive high voltage output and a negative high voltage output respectively. MUX5-MUX7 are points on the High Voltage Control assembly. MUX5 monitors the high voltage output. HV OUT is divided by R9-R13 and R64.

This divided output is connected to the output peak measure circuit which uses op amp U1B. In the dc V function, this circuit is a voltage follower. In the ac voltage function, this circuit is a peak detector.

The output of U1B charges C5 with R17 being the discharge path. This provides a positive dc voltage at MUX5. The output of the absolute value circuit is divided by R55 and R56 to generate MUX6. The output of the reference and error amplifier circuit is divided by R46 and R47 to generate MUX7.

HIGH VOLTAGE CALIBRATION 2-164.

Refer to Figure 2-28 for the following discussion. The resistor network, (70 kΩ and 7 MΩ) which is part of the HR7 hybrid/resistor network assembly, determines the accuracy of both 1100V ac and dc ranges. Calibration involves determining its offset and gain constants.

To determine the offset, DAC outputs are connected to 70 kΩ input resistor by K1. The output of the dc HV amplifier is inverted by U1 and its output is connected to the 7 MΩ feedback resistor by K9, K8B, and K6. This configuration creates an inverting amplifier with a gain of 100. Relay K9 connects the output of this amplifier to the RCL line, where it is measured by the adc circuit on the DAC assembly (A11). The DAC's adc circuit first connects both its +input and -input to RCOM and takes a checkpoint reading. The +input is then connected to the RCL line, which at this time is the amplifier output, and adjusts the DAC output to obtain the same reading as the previous check point. This offset cal constant is stored in nonvolatile memory.

To determine the gain, the High Voltage/High Current assembly is configured in the ac 1100V range, except PA SNS DC is connected directly to the 7 MΩ input resistor of the ac sense buffer by relays K8 and K6 instead of going through step-up transformer T1. The 6.5V reference (BRF6) is connected to the Power Amplifier assembly (A16) which is configured for an inverting gain of 20 to create a -130V output. The ac sense buffer circuit attenuates this signal by 100 to generate 1.3V at its output. This 1.3V is connected to the RCL line by relay K2 where it is connected to the +input of the adc circuit on the DAC assembly. DAC OUT HI, which is connected to the -input, is adjusted until a null is achieved. The gain can be determined by using this and the previous offset reading. This determines the exact ratio of 70 kΩ and 7 MΩ resistor network on the HR7 assembly. This known ratio can then be used to output very accurate dc voltages in 1100V dc range.

CALIBRATION OF THE AC FUNCTION 2-165.

The HR7 resistor network, previously calibrated at dc, is further characterized for its frequency response. The 5700A is placed in the ac 1100V range, except with HV OUT and HV SENSE tied by relay K11 on the High Voltage/High Current assembly (A15) instead of being tied at the load. The Oscillator Output assembly is set so the output of the High Voltage/High Current Voltage assembly is approximately 695V at 130 Hz. This high voltage output (INT HV SNS) is connected to the AC CAL line, through 399.6 kΩ resistor Z6, by relays K10 and K8A on the High Voltage assembly. The AC CAL signal is routed to the Oscillator Control assembly (A12) where it is measured by a 400Ω rms sensor.

Since the voltage is approximately 700V and it is applied through a 399.6 kΩ resistor (Z6) to the 400Ω rms sensor, approximately 1.75 mA of current flows through the rms sensor on the Oscillator Control assembly. A dc reading of the sensor, which is approximately 0.7V (1.75 mA x 400Ω), is taken and then stored in memory with the Oscillator Output level.

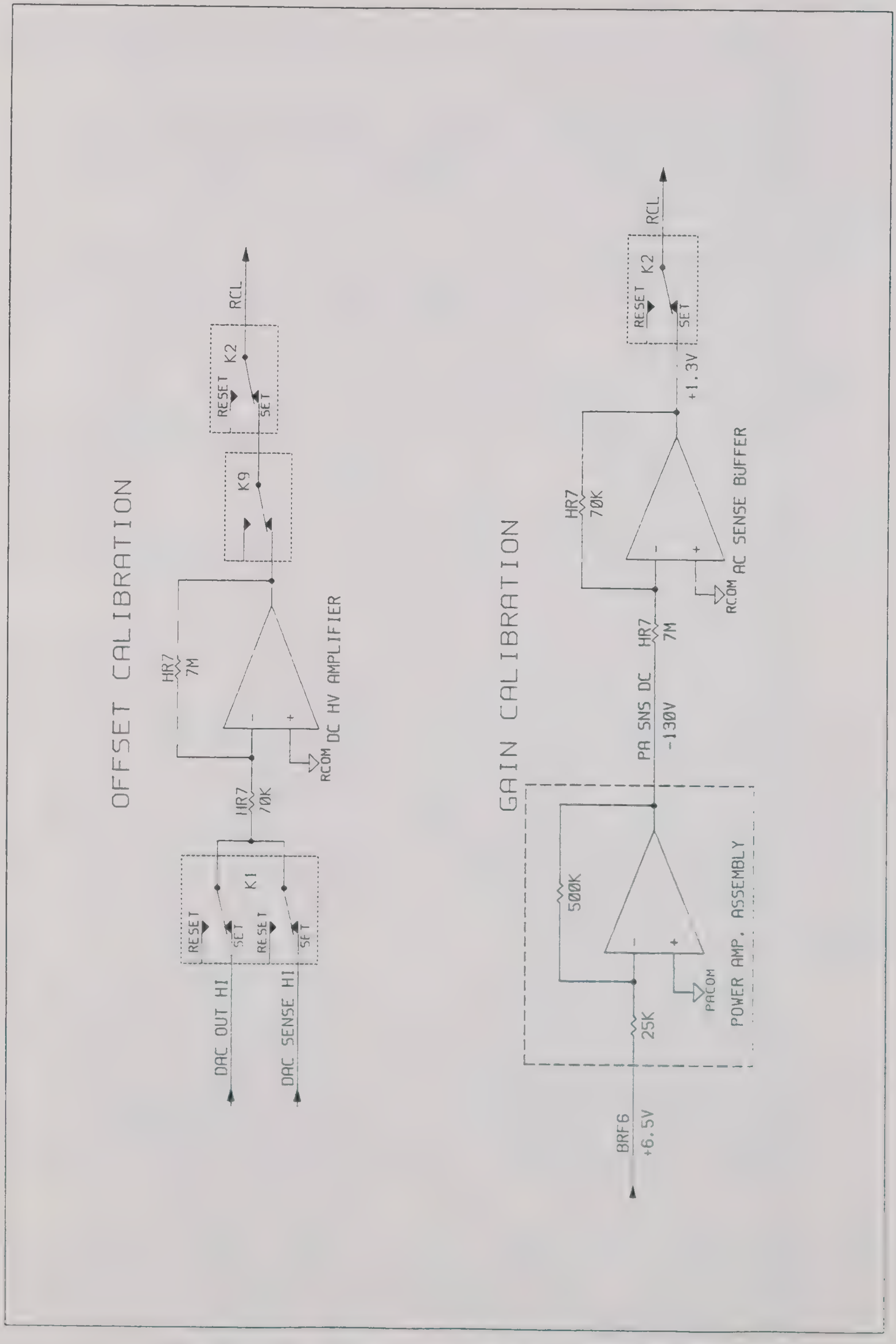


Figure 2-28. High Voltage/High Current Assembly Calibration

The Oscillator Output frequency is then increased to 500 Hz. The Oscillator Output level is adjusted so the dc reading from the rms sensor is the same as for 130 Hz, and stored in memory. This step is again repeated at 1 kHz. This characterizes the HR7 resistor network's frequency response. An accurate ac voltage can now be obtained at any frequency between 50 Hz and 1 kHz. The theory of operation for the rms sensor is contained in the Oscillator Control (A12) theory.

CALIBRATION OF THE CURRENT FUNCTION 2-166.

Refer to Figure 2-29 for the following discussion. The resistor network Z5 determines the accuracy of the 2.2A current range. Calibration involves determining its offset and gain constants. The 5700A is configured as in the 2.2A dc function, except that the Current assembly (A7) is set to the 2.2 mA range.

To determine offset, the output (B CUR) is routed back to the Current assembly where it is connected to INT OUT HI. INT OUT HI is routed to the Ohms Main assembly (A10), where it is connected to a previously calibrated 10Ω resistor. The voltage generated across this 10Ω resistor is routed to the differential amplifier on the Ohms Cal assembly (A9). The output of the differential amplifier is routed to the DAC assembly (A11) where it is measured by its adc circuit. A checkpoint reading is first taken by removing INT OUT HI from the 10Ω resistor and measuring the voltage across the resistor. The offset is then measured by connecting INT OUT HI to the 10Ω resistor. The DAC assembly, which controls the output of the Current assembly, is adjusted until the adc circuit measures the same as the previous checkpoint reading.

To determine gain, the 5700A is configured as in the previous step, except with the Current assembly outputting 1.3 mA generated from the 13V reference (BRF13 and BSRF13) from the DAC assembly. This 1.3 mA is amplified 100 times by the 2.2A amplifier. The resulting 130 mA is connected to the 10Ω resistor on the Ohms Main assembly by the same path as for the offset calibration. The resulting 1.3V across this 10Ω resistor is routed to the Ohms Cal assembly (A9), where it is connected to the -input of the differential amplifier. The +input of the differential amplifier is connected to the output of the DAC assembly. The output of the differential amplifier is connected to the RCL line which is routed to the adc circuit on the DAC assembly. The DAC output, which is the +input of the differential amplifier, is adjusted until a null is measured on the RCL line by the DAC's adc circuit. This step is repeated by changing the -input of the differential amplifier to the other side of the 10Ω resistor. The software now computes the exact voltage drop across the 10Ω resistor. Gain is determined by using this and the previous offset reading.

HIGH VOLTAGE MAGNITUDE CONTROL 2-167.

The square wave (HVCL) used in the previously described functions, is created and amplitude controlled by the High Voltage Control assembly (A14). This circuitry, shown on sheet 2 of the schematic, contains the absolute value circuit, signal/polarity selection circuit, reference and error amplifier, square wave generator, and the square wave amplifier.

The absolute value circuit contains op amp U2A, U2B, Q3, diodes CR8 and CR9, capacitor C20, and resistors R27-R32 and R68. During operation in the ac current function, this circuit creates an absolute value of the G OUT signal from the collectors of the 2.2A output transistors. Op amp U2A generates a negative half-wave signal equal to the positive peaks of G OUT. Resistors R32 and R27 sum this half-wave signal and the input signal G OUT at the input of U2B. Capacitor C20 averages the voltage so the output of U2B is a dc voltage which represents the positive peak voltage of G OUT. In the high voltage dc function, the 2.2A amplifier circuit is not used, so the output of U2B is 0V.

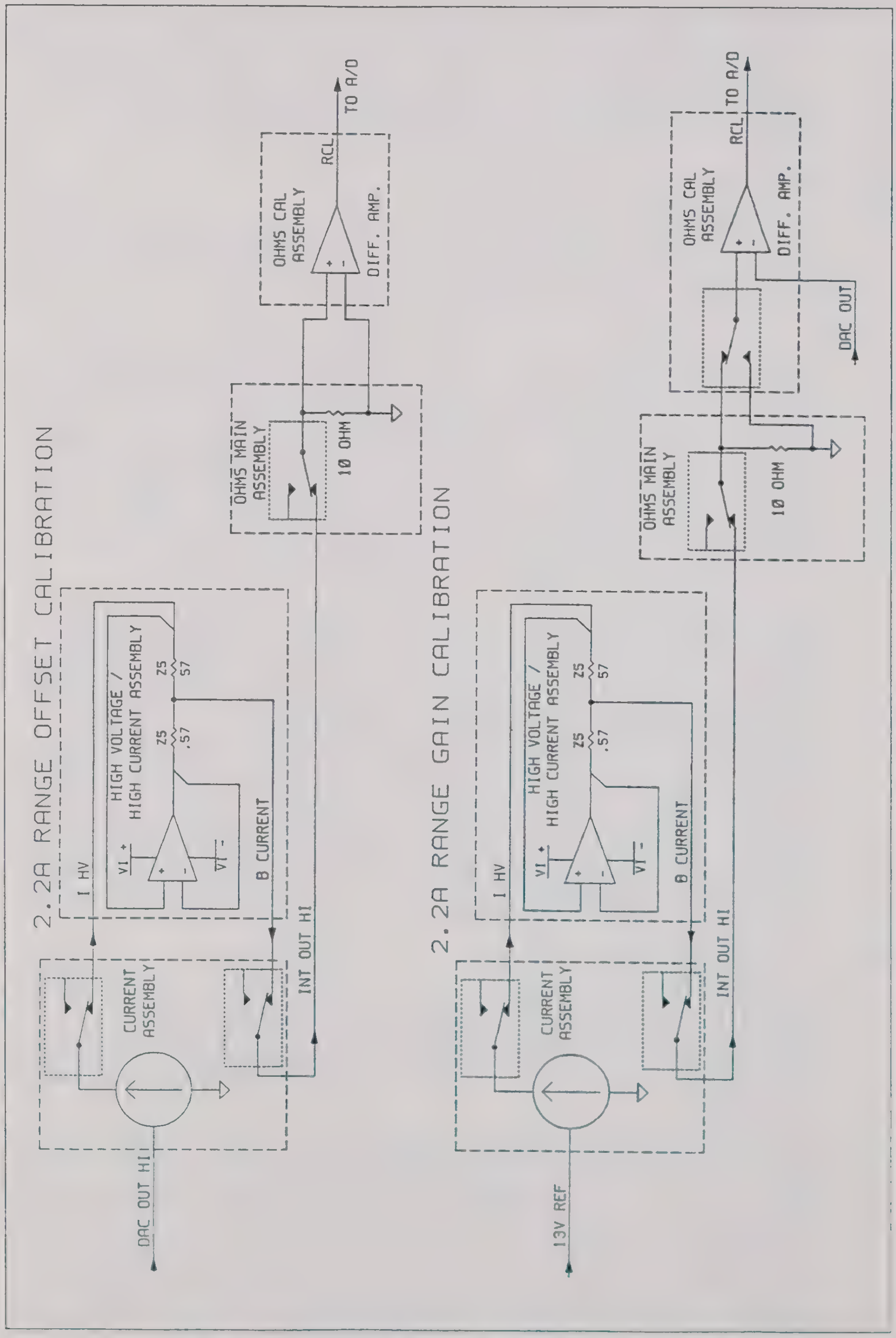


Figure 2-29. High Voltage/High Current Assembly 2.2A Range Calibration

The signal/polarity selection circuit generates the ERROR SIGNAL used by the error amplifier. It contains op amp U2C, CMOS analog switch U6, and resistor R35-R39. Control line V/I controls U6B and U6C which select the VI± when in the current mode. Control lines ±* and ± control U6A and U6D respectively. These switches, operating in conjunction with U6B and U6C, select between VI±, -SP C or +SP C. In the current function, U2C subtracts the power supply voltage (VI±) from the absolute voltage created by the absolute value circuit to create ERROR SIGNAL. This gives a measure of the emitter to collector voltage of the driving device for each operating function. In the positive dc voltage function, U2C is configured as a unity-gain inverting op amp. In the negative dc voltage function, U2C is configured as a voltage follower.

The reference and error amplifier circuit contains op amp U2D, CMOS analog switch U7B, zener diode VR1, transistors Q2 and Q4, diodes CR10-CR11, capacitor C18, and resistors R40-R45. Zener diode VR1, R40-R45, Q4, and U7B create a reference voltage. Control line V/I controls U7B which switches R43-R45 in or out to change this reference voltage value, depending on the operating function. In the HV dc range, R40 and R41 are used, balancing the error amplifier with the ERROR SIGNAL near 6.8V. In the 2A dc range, U7B and Q4 are on, R43 is paralleled with R41, and R45 is paralleled with R40, so the error amplifier balances when the ERROR SIGNAL is near 3.1V. In the 2A ac function, Q4 is off, R44 is in series with R45, so the error amplifier balances when the ERROR SIGNAL is about 5.2V. The output of U2C, ERROR SIGNAL, is summed with the reference voltage by R40 and R41. This voltage is connected to the error amplifier U2D which, with C18, is configured as an integrator. The error amplifier generates the signal AMPLITUDE, which dynamically controls the amplitude of the square wave. This AMPLITUDE is connected to the input of U7C. -AMPLITUDE, provided by inverting op amp U1A, is connected to the input of U7D. Control line PS OFF provides a soft start of the error amplifier. With this line high, Q2 is turned on, shorting C18, which sets the AMPLITUDE control line to 0V. Once the High Voltage/High Current assembly is set up for proper operation, this line goes low to turn off Q2.

The square wave generator circuit creates a 1 kHz signal QSQB and its complement QSQB*. These signals are generated by R26, C17, and astable multivibrator U4. Control line FREQ controls the CMOS analog switch U7A, which parallels R25 to R26. This changes the frequency of oscillation to prevent beating when putting out 2A ac near 1 kHz. Control line PS OFF goes high to shut down this oscillator when its not required.

The square-wave amplifier contains op amp U3 and CMOS analog switches U7C and U7D. Switch U5C is connected to the AMPLITUDE voltage and is controlled by QSQB from the square wave generator. Switch U7D is connected to AMPLITUDE through inverting op amp U1A and is controlled by QSQB* from the square wave generator. The input signal to the square wave amplifier is the output of U7C and U7D. Since QSQB* is the complement of QSQB, the resulting square wave has a positive peak equal to AMPLITUDE, and a negative peak equal to -AMPLITUDE. This square wave is amplified by U3, which is configured for a gain of 2.6, to create HVCL. HVCL is the square-wave signal used by the Power Amplifier assembly in the previously described functions.

Ohms Overview

2-168.

The Ohms function for the 5700A is provided by two plug in circuit boards, the Ohms Main assembly (A10) and the Ohms Cal assembly (A9). These two assemblies function as one to supply fixed values of resistance from 1Ω to 100 MΩ. Resistance output is available in values of 1×10^n (1, 10, 100, 1k ... 100M) and 1.9×10^n (1.9, 19, 190, ... 19M) from short to 100 MΩ. After the ohms function is calibrated, the Output Display shows the true value of the resistance selected.

These assemblies are also used to calibrate the 5700A Current function. The Ohms Main assembly contains all the resistor values except the 1Ω, 1.9Ω, and short, which are located on the Ohms Cal assembly. It also contains the relays and their drivers to switch these values as requested under program control.

The Ohms Cal assembly contains all calibration circuits except for one op amp on the Ohms Main assembly. It also contains a circuit to provide accurate calibration of two-wire ohmmeters. In addition, there are relays, relay drivers, and logic to interface the Ohms assemblies to the digital bus. Refer to Figure 2-30 for a simplified schematic of both the Ohms Main and Ohms Cal assemblies.

Ohms Main Assembly (A10) 2-169.

The Ohms Main assembly uses three Fluke hermetically-sealed thin film resistor networks (Z1, Z2 and Z3) to obtain values from 10Ω to 19 MΩ. The values are arranged in two strings, one for decade values and the other for the multiples of 1.9. The 100 MΩ value is achieved by inserting a 90 MΩ film resistor (R1) in series with the decade string.

SELECTION OF RESISTANCE VALUES 2-170.

Refer to Figure 2-31 for the following discussion. Relays select the resistance values. All resistor values have four-wire connections except 100 MΩ, which is two-wire. The output high and sense high side of a resistance value is connected to INT OUT HI and INT SENSE HI by relays K1 and K2 in the reset position, except 100 MΩ, which is connected to INT OUT HI by K5. Relays on the motherboard connect INT OUT HI and INT SENSE HI to the OUTPUT HI and SENSE HI binding posts.

The low side of the 1x string is connected to OHMS SENSE LO and OHMS OUT LO by relay K27 (A and B) in the reset position. The low side of the 1.9x string is connected to the same lines by relay K39 (A and B). These lines are routed to the Ohms Cal assembly where they are connected via relays to the OUTPUT LO and SENSE LO binding posts.

The 10 MΩ value is selected by K7 (reset) and K8 (energized) and the 1 MΩ value by K9 and K10 (reset). Selection of decades below 1 MΩ is done by K15 and K16 (reset) plus a pair of relays from K17 through K26A. For example, to select 10 kΩ, relays K18A and K20A are reset.

The 19 MΩ value is selected by K11 and K12 (energized), and the 1.9 MΩ value by K13 and K14 (reset). Selection of 1.9 decades below 1.9 MΩ is done by K35 and K36 (reset) plus a pair of relays from K18B through K26B and K37.

Two lines, OHMS OUT HI and OHMS SENSE HI, are brought over to the Ohms Cal assembly to connect to 1Ω, 1.9Ω, and short. These lines also access resistance values during calibration. Relay K29 connects OHMS OUT HI to the $1x10^n$ string when set, and to the $1.9x10^n$ string when reset. Relay K30 connects OHMS SENSE HI to the $1.9x10^n$ string during calibration.

Relays K3, K28, K31-K34, and op amp U1 and its associated components are only used during calibration. Operation of this circuitry is described in the "Calibration" part of the Ohms Cal theory.

Relays K4 and K6 are used during two-wire compensation. This is described in the "Two-Wire Compensation" part of the Ohms Cal theory.

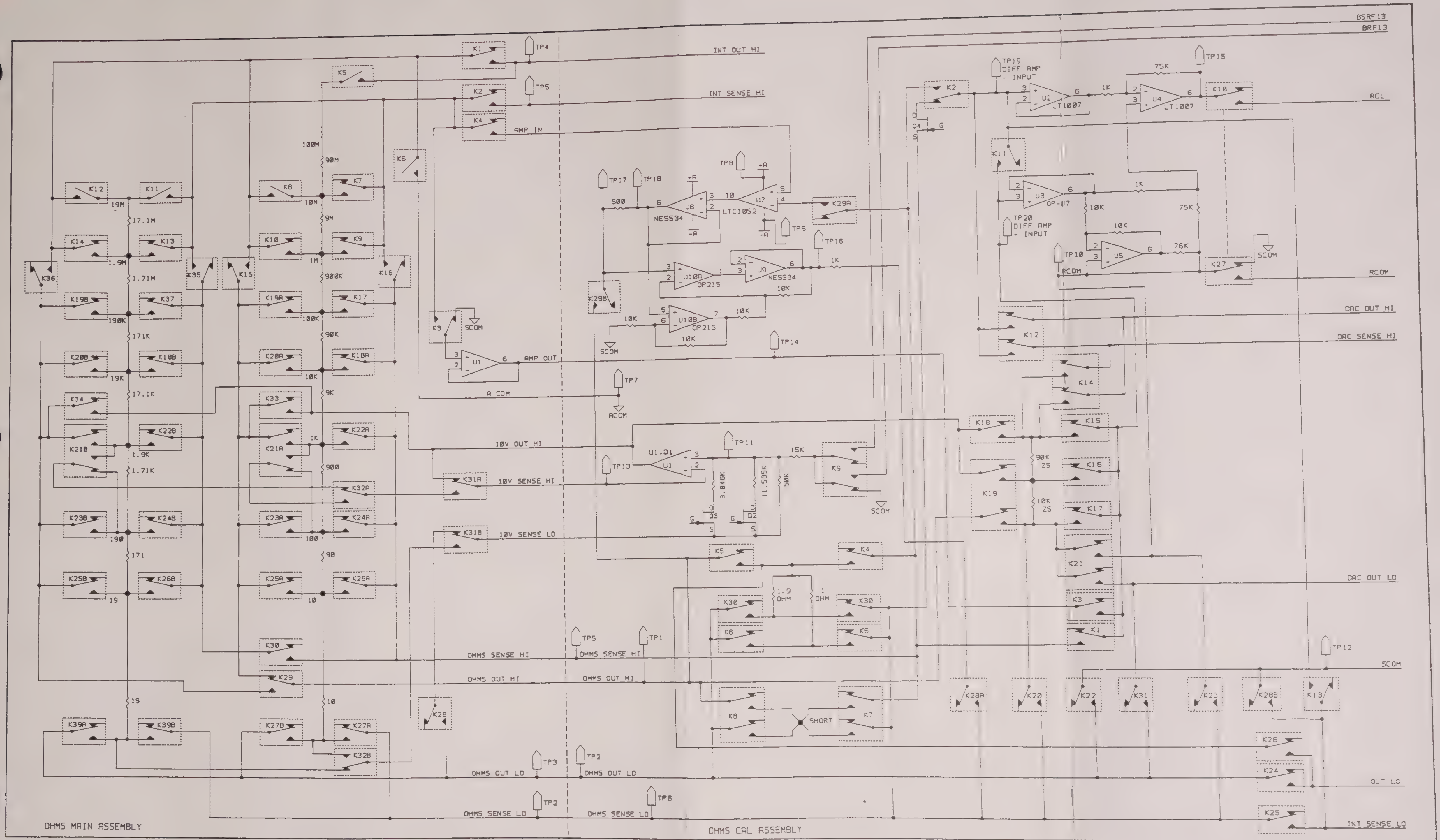


Figure 2-30. Ohms Assemblies Simplified Schematic

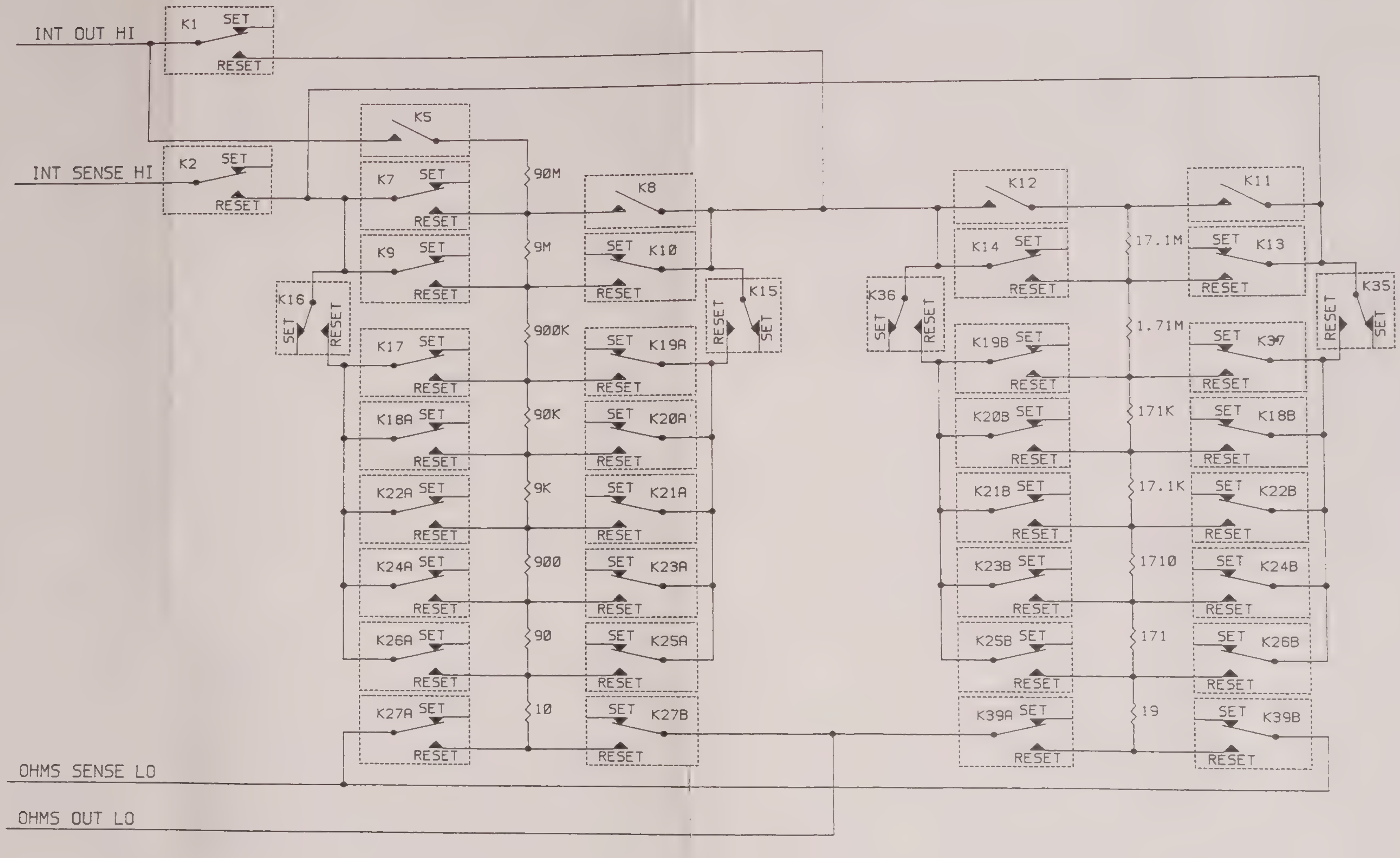


Figure 2-31. Ohms Main Assembly Simplified Schematic

OHMS MAIN ASSEMBLY SUPPORT OF CURRENT FUNCTION CALIBRATION 2-171.

To calibrate the current function, the Current assembly routes output current to the Ohms Main assembly, where it is connected through a resistance. Current is determined by measuring the voltage across this resistance. During calibration, half of K38 connects DAC OUT LO to the SENSE LO side of the 1x10^n string (Z1 pin 6). The Current assembly generates approximately 60 µA of current on the DAC OUT LO line, which can cause an error during measurement. To prevent this error, half of relay K38 connects the -17S supply through R6 to the DAC OUT LO line. This generates an opposite-polarity 60 µA current to cancel the current from the Current assembly.

OHMS DIGITAL CONTROL 2-172.

The Ohms Main assembly is digitally controlled by the 82C55 Programmable Peripheral Interface IC on the Ohms Cal assembly. This IC, under system software control through the guarded digital bus, has three ports generating 24 outputs. PA0-PA7 of port A, PB0-PB3 of port B, and PC0-PC4 of port C are routed on the motherboard to the Ohms Main assembly. These lines and two decoders in U9 and U10 control nine relay driver ICs, which in turn control 39 Ohms relays. Relay driver U3 drives non-latching relays K5, K6, K8, K11, K12 and K38. Relay drivers U2, U5-U8, and U11-U13 drive the latching relays.

Port A (PA0-PA7) is a common input bus for all relay drivers. IC U9 decodes PB0-PB3 to strobe the latching relay drivers. This signal causes the contents of the data on the input bus to be latched into the latch portion of the selected device. IC U10 decodes PC0-PC3 to provide four enable lines. Each line goes to two latch/drivers and when true (0V), drives the relay coils on or off according to the contents of the latch. Since these are latching relays, they are pulsed only briefly. The latching relays each have two coils, one to set the relay and one to reset it. When the ohms function is not being used, all relays are set, as shown on the schematic.

PC4 is the strobe line for non-latching relay driver U3. The enable is connected to LH COM so the relays receive constant drive. These non-latching reed relays are shown in the non-energized state.

Ohms Cal Assembly (A9) 2-173.

The Ohms Cal assembly (A9) contains the 1Ω, 1.9Ω, and short resistance values. It also contains a digital control circuit, and a two-wire compensation circuit to allow accurate calibration of two-wire ohmmeters. A differential amplifier circuit and a 2/5/10V source circuit are used during calibration of the ohms function.

OHMS CAL DIGITAL CONTROL 2-174.

The heart of the Ohms Cal assembly digital control circuit is the 82C55 Programmable Peripheral Interface IC (U11) mentioned previously under “Digital Control”. This IC has three ports generating 24 outputs. These outputs control seven 5801 latching relay drivers ICs (U14-U20), a 4051 analog multiplexer (U21) for self diagnostics, and several FET switches.

Port A (PA0-PA7) is a common input bus for latching relay drivers and multiplexer U21. These lines also go to the Ohms Main assembly as previously described to control relay drivers there.

Lines PB0-PB3 of port B goes to decoder U12 (PB3 is inverted by U22) and to the Ohms Main assembly. The output of U12 strobes latch/driver ICs to latch data on input bus lines.

Lines PC0-PC3 of port C go to decoder U13 and to the Ohms Main assembly. Decoder U13 enables two latch/driver ICs at a time. Setting the enable true (0V) causes the relay coils to be driven on or off depending on the contents of the latch portion of the selected ICs. Since these are latching relays, they are pulsed only briefly.

The outputs PB4, PB5 and PB6 of U11 are connected to the gates of FETs Q2, Q3 and Q4 respectively. The Programmable Peripheral Interface IC turns them on for a one (5V) and off for a zero (0V). PB7 is connected to the base of Q6 through R31. When PB7 is true (5V), it turns on Q6, which turns on Q5, which in turn supplies +17S to U6. PC4 goes to the Ohms Main assembly where it strobes relay latch/drivers for the non-latching relays.

Line PC6 goes to the diagnostic circuit where it enables and disables output from the multiplexer (U21). Connected to the input of the multiplexer are five voltage dividers made from resistors in Z3 and Z4.

Two inputs to these dividers are connected. One is 10V OUT HI from the 2/5/10V source circuit. The other is 2W COMP from the two-wire compensation circuit. These inputs are connected to the SDL line by the multiplexer, where they are routed to the adc circuit on the DAC assembly and measured during calibrator diagnostics. PC7 is not used.

1, 1.9, AND SHORT RESISTANCE 2-175.

Although located on the Ohms Cal assembly, the 1Ω value, 1.9Ω value, and short operate as part of the Ohms Main assembly, filling out the range of values available to the operator. The 1Ω value is made of four 4Ω wirewound resistors in parallel (R41). The 1.9Ω value is made of two 3.8 ohm wirewound resistors in parallel (R42). Relays K4 and K5 connect the 1 ohm and 1.9Ω values to OHMS OUT HI and OHMS SENSE HI. Relays K6 and K30 connect them to OHMS OUT LO and OHMS SENSE LO. Relays K7 and K8 select the short.

The Ohms Cal assembly contains the relays that switch the low side of the selected resistance onto the output bus. (High sides are connected to the output bus by relays on the Ohms Main assembly.) Relay K24 connects OHMS OUT LO to OUT LO and K25 connects OHMS SENSE LO to INT SENSE LO.

TWO-WIRE OHMMETER COMPENSATION CIRCUIT 2-176.

Refer to Figure 2-32 for the following discussion. The Ohms Cal assembly contains a two-wire lead drop compensation circuit that allows accurate calibration of two-wire ohmmeters. The error normally encountered when calibrating a two-wire ohmmeter is due to the voltage drop in the path resistance between the meter and the calibration resistor. This circuit reduces the voltage drop to an insignificant level. Two wire compensation can be used only with ohm meters that source continuous (not pulsed) dc current.

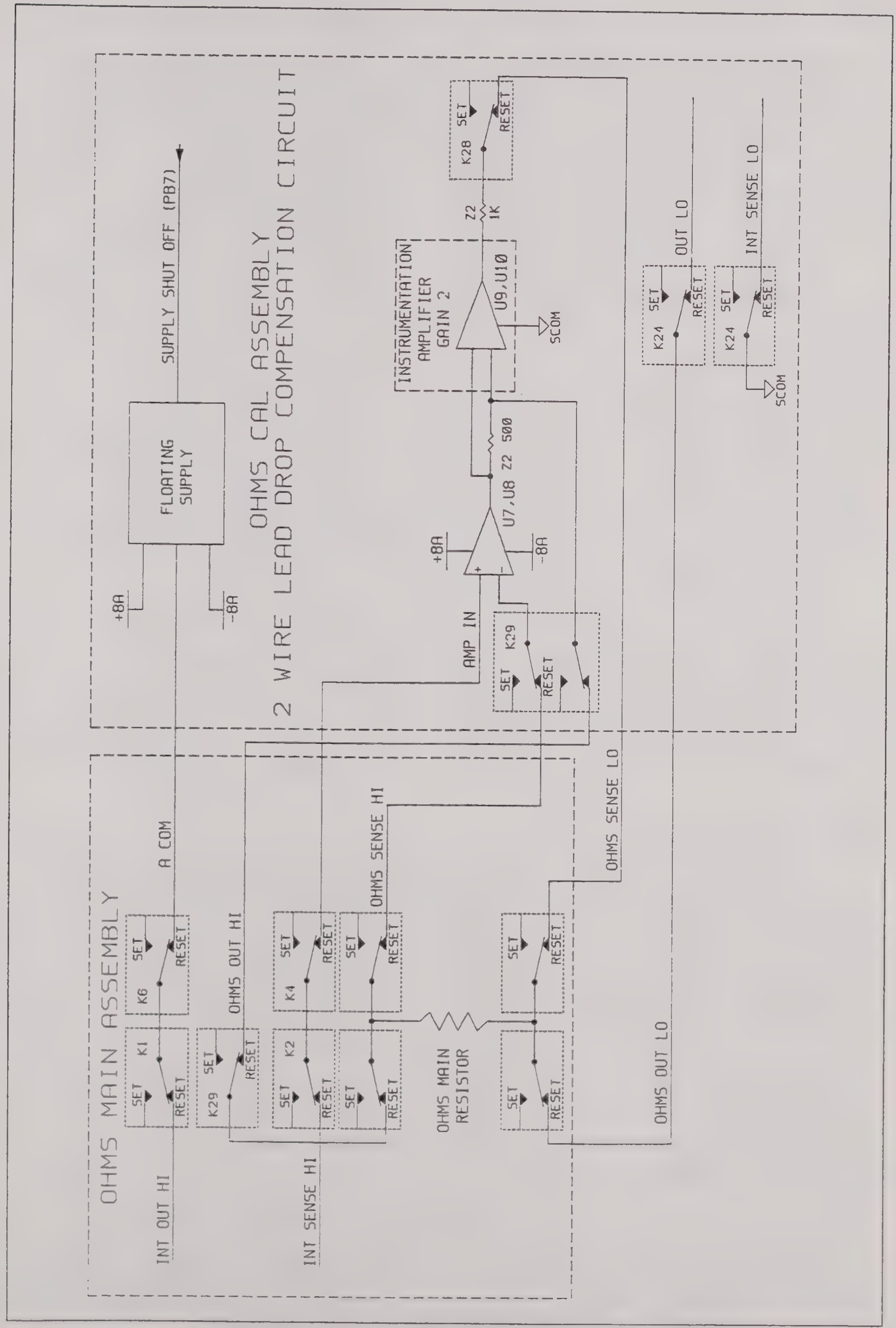


Figure 2-32. Two-Wire Lead Drop Compensatin Circuit

Two-Wire Compensation Power Supplies 2-177.

The floating supplies for U7 and U8 consist of a dc-to-dc converter made up of U6, T1 and associated components. Switching-regulator control IC U6 switches +17S through the primary of T1 at about 30 kHz as determined by R27 and C21. The switching creates high-frequency spikes on the +17S line which are filtered out by L2, R25, C18, C19, C20, and C52. When the two-wire compensation circuit is not in use, control line PB7 turns Q5 and Q6 off, which removes +17S, switching off U6. The secondary of T1 is rectified and filtered by CR1, CR2, CR9, CR10, C22, and C23. The voltage is then regulated by 8.2V zener diodes VR1 and VR2. Additional filtering is provided by L3, L4, R43, R44, C24, and C25. Two capacitors (C53 and C54) between A COM and S COM reduce switching noise that would otherwise appear across the calibration resistor.

High Side Cancellation 2-178.

The high side voltage drop is eliminated by U7 and U8. Chopper-stabilized op amp U7 and buffer amplifier U8 supply up to 10 mA. The current from the high side of the ohmmeter being calibrated enters at the OUTPUT HI binding post, goes through K1 and K6 on the Ohms assembly, and is routed to the Ohms Cal assembly where it connects to A COM. The A COM connection is a common for the floating supply that powers U7 and U8. The current then flows out of U8 through 500Ω in Z2 and through K29 to the calibration resistor via the OHMS OUT HI line.

K29 connects the -input of U7 to the sense point of the calibration resistance via OHMS SENSE HI. Relays K2 and K4 on the Ohms Main assembly connect the +input of U7, AMP IN, to INT SENSE HI. Relays on the motherboard connect INT SENSE HI to the OUTPUT HI or SENSE HI binding post. Connected this way, U7 controls the voltage at the output of U8 so that the voltage at the input of U7 stays zero. This forces the voltage drop in the path to zero. Diodes CR3-CR6 and resistor R45 provide protection for U7.

Low Side Cancellation 2-179.

The voltage drop in the low side path is cancelled by current from high current op amp U9. U9 is driven by dual FET input op amp U10. The two non-inverting inputs of U10 are connected across the 500Ω resistor in Z2. This enables U10, in conjunction with the four 10 kΩ resistors in Z2, to sense the current in the high side path and to supply (through U9 and the 1 kΩ resistor in Z2) a current equal but opposite to the current through the low side path. This cancels the drop in that path. This cancelling current goes through relay K28A to the low sense point of the calibration resistor via OHMS SENSE LO. From there it goes through the output low path to the OUTPUT LO binding post and then through the sense low path back to the Ohms Cal assembly and through K28B to S COM.

OHMS CALIBRATION 2-180.

The remaining circuitry is used only for calibration of the resistor values. All values except 1Ω and 1.9Ω are calibrated using a single external 10 kΩ resistance standard connected to the binding posts. The 1Ω and 1.9Ω values are calibrated using an external 1Ω standard. How to do the procedure is described in Section 7 of the Operator Manual.

Calibrating to the External 10 kΩ Standard 2-181.

Refer to Figure 2-33 for the following discussion. The first step in ohms calibration is to compare the 10 kΩ standard against the 10 kΩ value on the Ohms Cal assembly. This is done by passing a current through both values and measuring the voltage drop across each. The ratio of the voltages is equal to the ratio of the resistances.

The source of current comes from the 2/5/10V source circuit, which contains U1, Q1, Q2, Q3 and Z1. The buffered 13V reference voltage from the DAC assembly (A11) is switched through K9 to a voltage divider made up of resistors in Z1.

To calibrate the 10 kΩ resistance, control lines PB4 and PB5 turn off FETs Q2 and Q3 respectively. In this mode, the output of the divider uses the 15 kΩ and 50 kΩ values to produce an output of 10V. This voltage is buffered by U1 and Q1. The current from this source, 10V OUT HI, is sent through K19 to one side of the 10 kΩ resistance in Z5. 10V SENSE HI is connected to 10V OUT HI by K31A on the Ohms assembly. The other side of the 10 kΩ resistance in Z5 is connected to OHMS OUT HI by K19. This is routed to the Ohms Main assembly where is goes through K29, K15 and K1 to INT OUT HI, which is connected to the OUTPUT HI binding post by relays on the motherboard. From there it goes through the external 10 kΩ standard and back in through the OUTPUT LO binding post and over to the Ohms Cal assembly where it connects to S COM through K24 and K22.

The voltage drops are measured by comparing each voltage to the DAC assembly output in a differential amplifier circuit made of U2 through U5.

Since the DAC and differential amplifier are referenced to R COM, this line is brought out through K27, K23 and K25 to INT SENSE LO. This is connected to the SENSE LO binding post (which is connected to the sense low point of the standard). Line DAC OUT LO is tied to S COM by relay K31. The high side of the DAC, DAC OUT HI and DAC SENSE HI, are tied together and connected by K12 to U2, which is the differential amplifier -input.

The voltage to be measured is connected to U3, which is the differential amplifier +input. The output of U2 and U3 goes to U4 through gain setting resistors in Z1. These set the gain of the differential amplifier to 75. The differential amplifier generates a current through the 1 kΩ (pins 1-2) and 75 kΩ (pins 2-3) resistors in Z1 to R COM. This current on R COM can cause an error during measurement. Op amp U5, configured as an inverting amplifier, generates an equal current of opposite polarity through 76 kΩ resistor R18 to cancel the current from the differential amplifier. The output of U4 goes through K10 to the RCL line. This line is connected to the DAC assembly, where it goes through an amplifier to the adc circuit.

The calibration program uses the adc circuit to measure the differential amplifier output voltage. First the differential amplifier offset voltage is determined. (This offset is different for each input condition.) Readings are taken to determine each offset voltage by checking the output of the differential amplifier at equal voltages on the inputs. This is done by switching K11 to the reset position to connect the differential amplifier +input and -input together, then measuring the output with the DAC's adc circuit.

Once the offsets are known, the software determines the calibration voltages by adjusting the DAC output until the adc reading is the same as the offset. At that point, the DAC output equals the voltage being measured.

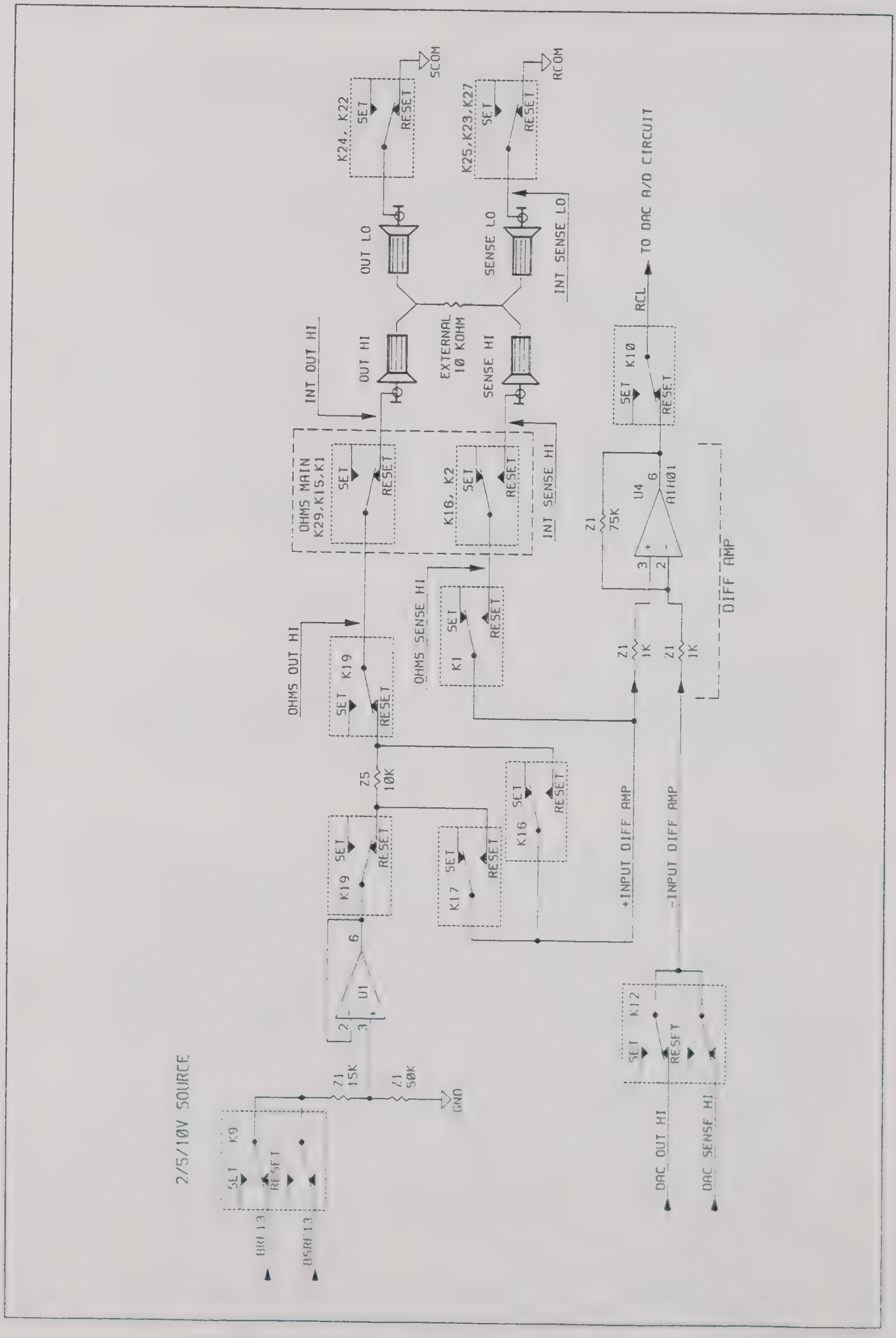


Figure 2-33. Calibration to an External 10 kΩ Standard

Three readings are required to determine the ratio of the two resistances. For the first reading, K16 connects the differential amplifier +input to the 10 kΩ resistor in Z5. For the second reading, K17 connects the +input to the other side of that resistor. Subtracting the first reading from the second gives the voltage across the internal 10 kΩ. For the third reading, K1 on the Ohms Cal assembly connects the + input to OHMS SENSE HI. OHMS SENSE HI is connected to INT SENSE HI by K16 and K2 on the Ohms Main assembly. INT SENSE HI is connected to the SENSE HI binding post by relay K2 on the motherboard which is the sense high side of the 10 kΩ external standard. The ratio of this third reading to the difference of the first two readings is proportional to the ratio of the two resistances. Thus by knowing the resistance of the external standard, the software can calculate the value of the internal 10 kΩ resistance value.

Calibrating 10 kΩ and 19 kΩ 2-182.

The next step in calibrating the ohms function is to determine the 10 kΩ and 19 kΩ values on the Ohms Main assembly. This is done just like the 10 kΩ value on the Ohms Cal assembly, except the 10 kΩ resistance on the Ohms Cal assembly acts as the standard and is placed in series with 10 kΩ or 19 kΩ on the Ohms assembly.

This is done using K19 on the Ohms Cal assembly and K29, K20A and K27 on the Ohms Main assembly for the 10 kΩ, and K29, K20B and K39 for the 19 kΩ value. The source on the Ohms Cal assembly again outputs 10V. Again three readings are taken. The first and second are the same as previously described. For the third reading, the differential amplifier +input is connected through K1 on the Ohms Cal assembly and through K18A on the Ohms Main assembly for 10 kΩ and K30 and K18B for 19 kΩ. The software then calculates the 10 kΩ and 19 kΩ values using the ratio of readings and the known value of the 10 kΩ on the Ohms Cal assembly.

Calibrating 100 kΩ 2-183.

Once the 10 kΩ value is determined, the 100 kΩ value is calibrated by comparing its value against 10 kΩ. The 10V source is connected across 100 kΩ. Since the 10 kΩ resistance is used as part of 100 kΩ, the current goes through both.

Relays K33 and K19A on the Ohms Main assembly connect 10V OUT HI to 100 kΩ. Relays K23 and K27 on the Ohms Cal assembly connects OHMS SENSE LO to RCOM. OHMS OUT LO, DAC OUT LO, and 10V SENSE LO are connected to SCOM. Relay K22 on the Ohms Cal assembly connects OHMS OUT LO to SCOM. OHMS OUT LO is connected to DAC OUT LO by K31 on the Ohms Cal assembly, and to 10V SENSE LO by K31B and K28 on the Ohms Main assembly.

Only two readings are required because this time there is no path resistance to subtract out. DAC OUT HI and DAC SENSE HI are tied together and connected to the -input of the differential amplifier by relay K12.

For the first reading, the +input of the differential amplifier is connected to the sense side of the 100 kΩ point in the string through K1 on the Ohms Cal assembly and K17 on the Ohms Main assembly. For the second reading, the + it is connected to the 10 kΩ point by K18A. The software calculates the 100 kΩ value from the ratio of the readings and the known 10 kΩ value.

Completion of High Resistance Value Calibration 2-184.

Once 100 kΩ is determined, 1 MΩ and the other values up to 100 MΩ are determined in a similar way. Using the same techniques, 190 kΩ is calibrated against 19 kΩ, and so forth up to 19 MΩ.

Too much current noise is generated by U3 in the differential amplifier circuit for accurate calibration of resistances above 1 MΩ. For these values, U1 on the Ohms Main assembly (a low-bias current FET op amp) is switched ahead of U3.

The 1 kΩ and 1.9 kΩ resistance values are determined from the 10 kΩ and 19 kΩ respectively.

The 10Ω, 19Ω, 100Ω and 190Ω resistance values are determined using 2V from the 2/5/10V source and using internal 10:1 divider (Z5) in conjunction with the DAC. To get 2V, Q2 and Q3 are both turned on, which parallels both the 11.535 kΩ value and the 3.846 kΩ value with the 50 kΩ value. The lower voltage is required to lower the power dissipation in the resistors.

Using 2V presents a problem for the DAC. Instead of working at 10V and 1V, it would be working at 2V and 0.2V. This level is too low to get accurate results from the DAC. To solve this problem, the DAC is used only at 2V and the 0.2V level is achieved using a 10:1 divider. The DAC calibrates this 10:1 divider at 10V and 1V. The divider is made of a 90 kΩ and a 10 kΩ resistor in Z5. To calibrate the divider, 10V is applied to the top of the divider through K18. The low side of the divider is connected to R COM (K21 and K27), DAC OUT LO (K21) and S COM through K20 on the Ohms Cal assembly, K27A/B on the Ohms Main assembly and K22 on the Ohms Cal assembly. Two readings are taken. Their ratio is equal to the division ratio of the divider. The -input of the differential amplifier is connected to the DAC output by K12. For the first reading, K15 connects the top of the divider to the +input of the differential amplifier. For the second reading, K16 connects the divider point to the +input of the differential amplifier. The exact ratio of this divider can now be determined by these two readings.

Refer to Figure 2-34 for the following discussion. To calibrate the 10Ω resistor, the DAC output is connected to the top of the divider by K14. The 2V source is connected across 100Ω on the Ohms Main assembly. This is done by 10V OUT HI, set to 2V, connected to the high side of the 100Ω string by K33 and K23A on the Ohms Main assembly. Line 10V SENSE HI is also connected to this point by K31A and K32A on the Ohms assembly. Line OHMS OUT LO and OHMS SENSE LO are connected to the low side of the 100Ω string by K27B and K27A respectively. Line OHMS OUT LO is connected to SCOM by K22 on the Ohms Cal assembly and is also connected to 10V SENSE LO by K32B and K31B on the Ohms Main assembly. OHMS SENSE LO is connected to the low side of the internal divider by K20 on the Ohms Cal assembly. The Ohms Cal assembly also connects RCOM to the low side of the divider by K27 and K21. Relay K21 also connects this point to DAC OUT LO.

Two measurements are taken. The first is with the +input of the differential amplifier connected to the DAC output through K15. The - input is connected to the sense point of the 100Ω resistance by K24A on the Ohms Main assembly and K2 on the Ohms Cal assembly. The DAC is adjusted until its value is the same as the voltage across 100Ω. Then the inputs of the differential amplifier are moved. The +input is connected to the divider output on the Ohms Cal assembly by K16. The - input is connected to the sense point of the 10Ω resistance by K26A on the Ohms Main assembly and K2 on the Ohms Cal assembly. The DAC is again adjusted until the voltages are equal. The differential amplifier sees 0.2V on each input for this measurement but the DAC is at 2V. The value of 10Ω is determined from the two DAC settings and the division ratio of the divider on the Ohms Cal assembly. The same procedure is used to determine the 100Ω value from the 1 kΩ value, the 190Ω value from the 1.9 kΩ value and the 19Ω value from the 190Ω value.

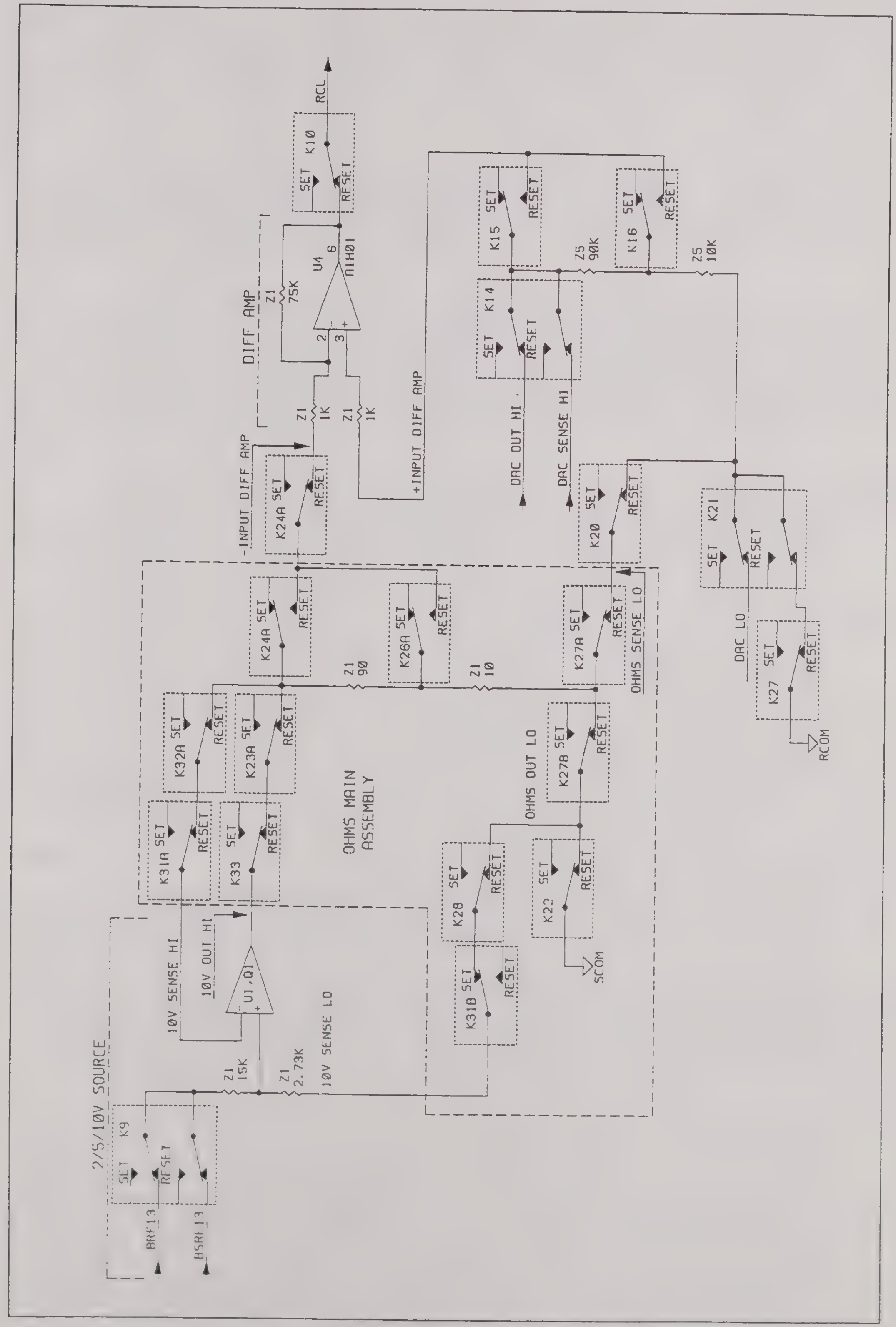


Figure 2-34. Ratio Calibration, 10Ω From 100Ω

Calibrating to the External 1Ω Standard 2-185.

The 1Ω and 1.9Ω resistor values are calibrated by comparing them against a 1Ω external standard. The technique used is different from that used for the 10 kΩ external standard.

The Current assembly supplies a 130 mA (65 mA for 1.9Ω calibration) current through both resistors. This current goes out the OUTPUT HI binding post to the 1Ω standard. It comes back in through the OUTPUT LO binding post and through the internal 1Ω resistance by K26 and K6, or 1.9Ω by K26 and K30 before going to S COM through K22.

For the first reading, the inputs to the differential amplifier are connected across the sense points of the 1Ω standard. Relay K1 connects the differential amplifier +input to OHMS SENSE HI, which is connected to INT SENSE HI by K16 and K2 on the Ohms Main assembly. INT SENSE HI is connected to the SENSE HI binding post by relays on the motherboard. Relay K13 connects the differential amplifier -input to INT SENSE LO which is connected to SENSE LO binding post by relays on the Switch Matrix assembly.

The voltage between the inputs is 0.13V, which is amplified by 75 by the differential amplifier to approximately 9.75V and sent to the DAC assembly on the RCL line. Another differential amplifier on the DAC assembly compares the 9.75V to the DAC output. Before the reading is taken, however, amplifier offsets are determined.

When the DAC output equals the output of the differential amplifier on the Ohms Cal assembly, the reading is stored and a second reading is taken. For this reading, the inputs to the differential amplifier on the Ohms Cal assembly are connected across the 1Ω or 1.9Ω on the Ohms Cal assembly. The +input of the differential amplifier is connect through K1 and K4 and the -input is connected through K2 and FET Q4. The second reading is taken the same way as the first. The ratio of the two DAC settings are equal to the ratio of the values of the two resistors. The value of the 1Ω and 1.9 ohm resistors are determined from this ratio and the value of the external standard.

Current/High Resolution Oscillator Assembly Overview (A7) 2-186.

The Current/Hi-Res (High-Resolution Oscillator) Assembly combines two functions on one circuit board. The Current section generates dc and ac currents in the range of 20 μA to 220 mA. The Hi-Res section generates a high-resolution signal accurate in frequency to 4 1/2 digits, which is used by the phase-locked loop circuit on the Oscillator Output assembly (A13). These two functions are independent circuits except for the sharing of some digital controlling and self-diagnostic monitoring. The following theory describes the digital control circuitry used by both circuits, then independently covers the Current and Hi-Res functions.

The heart of the Current/Hi-Res assembly digital control circuitry is a 82C55 Programmable Peripheral Interface IC (U7), which is under software control via the guarded digital bus. This IC has three ports which generate 24 outputs. These outputs control three UCN5801 latching relay drivers ICs (U8-U10), a UCN5800 relay driver (U11) for controlling non-latching relays, a 4051 analog multiplexer (U12) for self diagnostics, and several FET switches throughout the assembly. Port A (PA0-PA7) is a common input bus called CONTROL BUS on the schematic. This CONTROL BUS transmits the desired state of all the relays (K1-K17) in the Current section, and also to control two synthesizer ICs (U16, U17) in the Hi-Res section.

Four relay driver ICs drive latching controlling relays K1-K13 and K16. The CONTROL BUS (port A of U7) is a common input bus. Port C of U7 (PC0-PC5) provides the strobe and enable lines for these relay drivers. PC0 enables U8, while PC1 enables U9 and U10. PC2, PC3, PC4, and PC5 strobe U11, U8, U9, and U10 respectively.

Relay driver U11 controls the three non-latching relays K14, K15, and K17 on this assembly. It also generates control line RLY11* to control K11 on the Motherboard. Relay K11 routes I-GUARD, described later, to the rear panel for operation when the rear-panel binding posts are in use.

The diagnostic circuit allows the calibrator to monitor five points on the assembly. Points DUMMY LOAD, OVEN TEMP, and CUR/COMP MONITOR are from the Current section. Points HI-RES LOOP and HI-RES CLOCK come from the Hi-Res section. Outputs PB0-PB2 select which point the multiplexer U12 monitors. PC6 enables the output of U12 to the SDL line, where it is measured by the adc circuit on the DAC assembly (A11).

Outputs PB3-PB5 generate control lines FET3, FET1, and FET2 respectively, which are used by the Current section. FET1 controls NMOSFETs Q21 and Q22, FET2 controls Q20 and Q23, and FET3 controls quad CMOS analog switches U5A, U5C, and U5D. Output PB7 generates control line FET4, which controls analog switch U5B.

Outputs PB6 and PC7 generate control lines HI-RES RANGE and HI-RES ON/OFF respectively, which are used by the Hi-Res section. These lines control quad CMOS analog switch U18 and comparator U13.

CURRENT SECTION 2-187.

The current section of the A7 assembly uses dc voltage from the DAC assembly and ac voltage from the Oscillator Output assembly to generate both ac and dc current outputs. Four ranges of output current each for ac and dc are generated as shown in Table 2-14. AC current is available from 40 Hz to 10 kHz.

The 2.2A range is generated on the High Voltage/High Current assembly (A15) and routed to this assembly for switching to the OUTPUT binding posts. This is further described under the heading, "2.2A Range."

The transconductance amplifier, shunt resistors, feedback loop, and complementary drive circuits form a loop to create the output current. In addition to these circuits, the Current assembly contains input switching, output switching, a current guard, and a current/compliance voltage monitor. Each of these circuits is described in detail. To better understand the theory of operation, refer to Figure 2-35 and the schematic.

Table 2-14. AC and DC Current Ranges

RANGE	DC CURRENT LIMITS	AC CURRENT LIMITS
220 μA	0 to 219.9999 μA	9.000 μA to 219.999 μA
2.2 mA	0.220000 mA to 2.199999 mA	0.22000 mA to 2.19999 mA
22 mA	2.20000 mA to 21.99999 mA	2.2000 mA to 21.9999 mA
220 mA	22.0000 mA to 219.9999 mA	22.000 mA to 219.999 mA

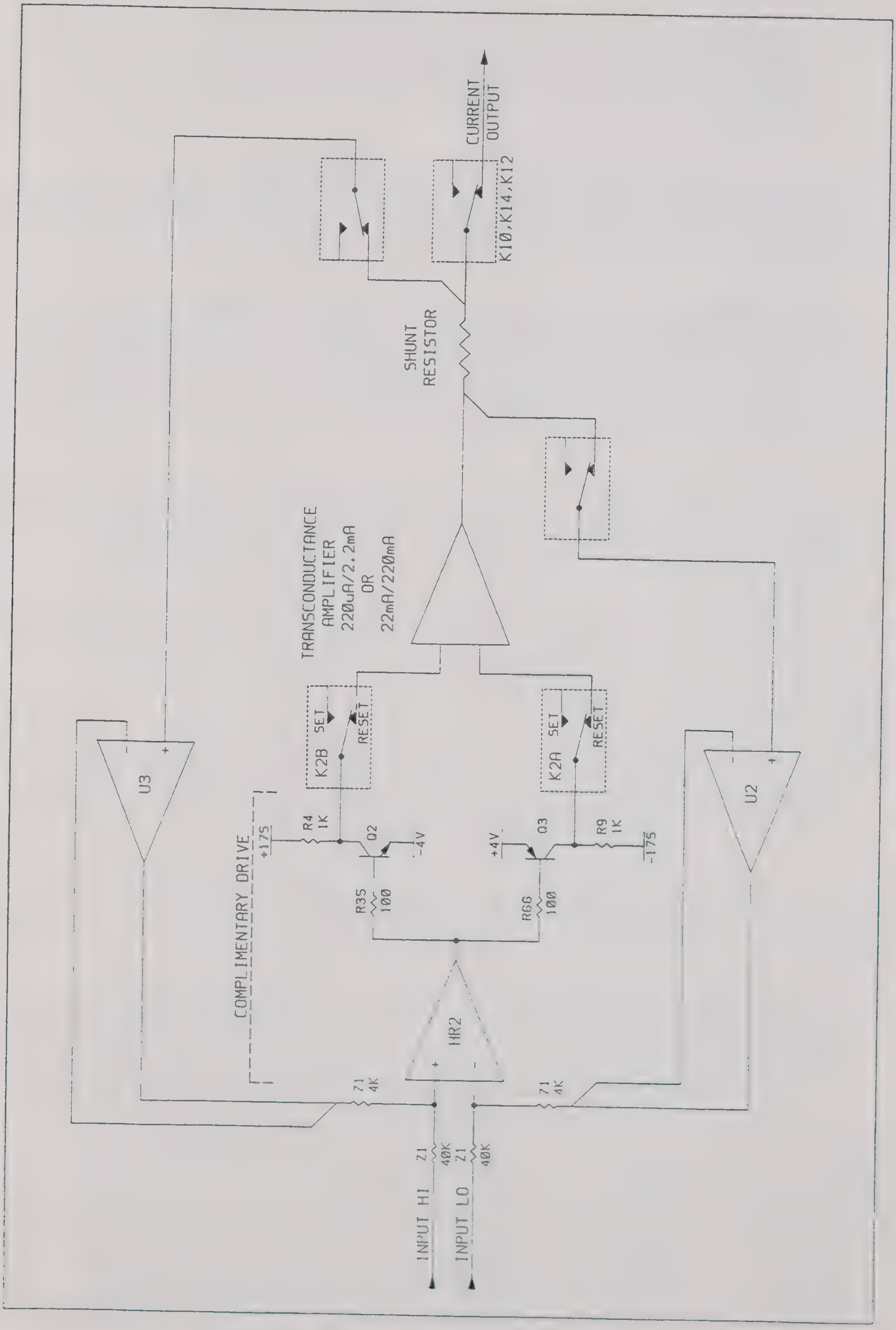


Figure 2-35. Current Output Simplified Schematic

Current Input Switching 2-188.

Relay K1, CMOS analog switch U5B, and FETs Q20-Q23 select the input source voltage. For dc operation, the 22V range of the DAC assembly (A11) is brought in on the B IN and B FB lines from the Switch Matrix assembly (A8). For ac operation, the 22V range of the Oscillator Output assembly (A13) is brought in on the B IN and B FB lines. During calibration of the current functions, the 13V buffered dc reference BRF13 and BSRF13 are selected when K1 is set and U5B is closed.

The input signal return paths are selected for ac or dc operation by control lines FET1 and FET2, and NMOSFETs Q20-Q23. With a dc or 13V reference input, control line FET1 goes high, turning on Q21 and Q22, connecting RCOM and DAC OUT LO to the respective circuit. For ac current input, control line FET2 goes high, turning on Q20 and Q23, connecting OSC SENSE LO and OSCOM to the respective circuit.

Complementary Drive Circuit 2-189.

The circuitry containing transistors Q2, Q3, Q18 and Q19 provides the complementary drive to the output transconductance amplifiers from the single-ended output dc amplifier on hybrid HR2. Transistors Q2 and Q18 provide the drive during a positive input, while Q3 and Q19 provide the drive during a negative input. Relay K2 switches the drive to the 220 µA/2.2 mA transconductance amplifiers when reset, or to the 22 mA/220 mA transconductance amplifier when set.

The HR2 assembly consists of an op amp mounted on a heated-substrate hybrid, bonded to the shunt resistor network. The HR2 assembly gives this circuit excellent dc characteristics of low offset, noise and drift. The hybrid heater control circuit, outlined on sheet 2 of the schematic, adjusts the base voltage of Q1 to deliver the proper power to the heater resistor. This maintains the HR2 assembly at a constant temperature in spite of environmental temperature variations. Transistor Q14 protects the hybrid in case Q1 fails.

Transconductance Amplifiers 2-190.

The transconductance amplifiers are the 220 µA/2.2 mA range amplifier the 22 mA/220 mA range amplifier circuits. The 220 µA and 2.2 mA ranges are provided by the 220 µA/2.2 mA range transconductance amplifier, containing transistors Q4, Q5, and relay K3. With relay K3 reset as shown on schematic, the amplifier is in the 220 µA range. To place the amplifier in the 2.2 mA range, relay K3 is set so emitter resistors R10 and R12 are shunted by R11 and R13 respectively.

The the 22 mA/220 mA range transconductance amplifier contains transistors Q6-Q13 and relay K4. It provides the 22 mA and 220 mA ranges. In the 22 mA range, the transconductance amplifier is composed of Q6-Q9 with K4 in the reset position. In the 220 mA range, the transconductance amplifier is composed of Q6-Q13 with K4 in the set position. In this range, Q10-Q13 are in the Darlington configuration with Q6-Q9 respectively. This provides the additional current gain needed for the 220 mA range.

Shunt Resistors 2-191.

A resistor network is used to sense the output current in each of the four current ranges. This network is composed of four four-terminal resistors attached to the heated substrate of HR2. The shunt resistors are 10 kΩ for the 220 µA range, 1 kΩ for the 2.2 mA range, 100Ω for the 22 mA range, and the 10Ω for the 220 mA range. Relays K5-K9 select the INPUT, OUTPUT, and SENSE binding posts for each of the four ranges as Table 2-15 shows.

Feedback Loop 2-192.

The output current develops a 2.2V full-scale voltage across the appropriate shunt resistors. Buffer amplifiers U2 and U3 isolate the shunt from the remaining feedback circuit. The negative feedback buffer is op amp U2 configured as a voltage follower. The positive feedback buffer is made of U3 configured as a voltage follower.

Both the feedback voltage from U2 and U3, and the input voltage from K1 and Q20-Q23 are applied to the precision dual 10:1 matched voltage divider network Z1. Any voltage difference between the two halves of the network is amplified by the dc amplifier on the heated substrate hybrid HR2. This amplified dc is applied to the complementary drive circuit and in turn to the transconductance amplifiers to complete the feedback loop.

Therefore, with a 22V full scale input and the 10:1 divider, the voltage across the shunt network is forced to 2.2V by the feedback loop. The 2.2V across the shunt is developed by the full-scale output current on any of the four ranges. By programming the input voltage over a 10:1 range, the output current follows with a 10:1 range. By switching the shunt resistors, four 10:1 ranges give a total output range of 20 μA to 220 mA.

Current Output Switching 2-193.

Relays K10-K15 switch the output current for the various modes of operation required by this assembly. When K13 is reset, it switches in a dummy load (R14) to prevent transients during switching, and also for use during diagnostics. Non-latching relay K15 connects the return lines to the output whenever an output is called for. Non-latching relay K14 connects the output signal to latching relay K12. Relay K12 switches the output to the AUX CURRENT OUTPUT binding post while in the reset position, or to the OUTPUT HI binding post while in the set position.

The four ranges of output current can be connected to the B CUR line by relay K11. B CUR is routed to the rear-panel 5725A connector. This allows all current ranges to be available from the binding posts on the 5725A Amplifier if so selected by the operator.

Generation of the 2.2A Range 2-194.

To generate the 2.2A range, the Current assembly is set to the 22 mA range with its output directed to the High Voltage/High Current assembly (A15). This connection is made via the IHV line by relay K10 in the set position. The High Voltage/High Current assembly amplifies current by 100 to create the 2.2A range. This high current output is returned to the Current assembly via the B CUR line. Relay K11 in the set position directs it to the output relays, K12-K15, of the Current assembly.

Table 2-15. Relay Settings for Current Range Selection

RELAY	RANGE			
	220 μA	2.2 mA	22 mA	220 mA
K5	R	S	S	S
K6	R	S	R	R
K7	R	S	R	R
K8	R	R	S	R
K9	R	R	R	S

S=SET R=RESET

During internal calibration of the 2.2A range, the Current assembly is set to the 22 mA or 2.2 mA range and directed to the High Voltage assembly in the same manner as previously described.

Internal calibration of the 2.2A range and gain of the High Voltage/High Current assembly is discussed further in the theory for the High Voltage assemblies.

Current Guard Buffer 2-195.

Buffer amplifier U4, configured as a voltage follower, is used to provide a guard voltage equal to the output voltage across the external load. The guard voltage, if used, prevents any output current from being shunted away from the load due to leakage or shunt capacitance in the system cabling.

Compliance Limiter 2-196.

A compliance limiter circuit consisting of Q24, Q25, and associated components clamps the output to ±11V during an over-compliance condition.

Current/Compliance Voltage Monitor 2-197.

The current/compliance voltage monitor circuit, which contains CMOS analog switch U5A, U5C, U5D, op amp U6, and associated components, measures the voltage on either side of the current shunts. This allows the 5700A to detect an over-current or over-compliance condition. A logic low on control line FET3 closes U5A to connect the monitor circuit to the input side of the shunt resistor. The measurement at this point is the sum of the output compliance voltage and voltage drop across the shunt, which is proportional to the output current. A logic high on control line FET3 opens U5C, which allows pull-down resistor R36 to close U5D. This connects the monitor circuit to the output side of the shunt resistor, which gives the output compliance voltage.

Op amp U6 and associated components create an absolute value circuit whose output, CUR/COMP MONITOR, is always a positive dc voltage. During operation in the ac current function U6B generates a negative half-wave signal equal to the positive peaks of its input. Resistors R31 and R30 sum this half-wave signal and the input signal at the input of U6A. Capacitor C14 averages the voltage so the output of U6A is a dc voltage which represents the average value of the selected input.

The diagnostic circuit connects CUR/COMP/ MONITOR to the SDL line, on which it is routed to the DAC assembly (A11) to be measured by the adc circuit. The calibrator software computes the difference between the two measurements and divides the result by the shunt value to determine the output current.

Current Assembly Calibration 2-198.

Refer to Figure 2-36 for the following discussion. Internal calibration of the Current assembly is a process of determining the offset and gain constants for each of the four current ranges.

To determine the offset of the 220 mA range, the Current assembly is set to the positive dc 220 mA range with its input from the DAC assembly set to 0V. The output of the Current assembly is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the previously calibrated 100Ω resistor.

To get a checkpoint reading, the Current assembly output is removed from the 100/Q resistor on Ohms (via the output switching relays). The 100Ω resistor is connected to a differential amplifier on the Ohms Cal assembly (A9). The output of this differential amplifier is connected to RCL, which is routed to the adc circuit on the DAC assembly. The adc circuit measures the voltage, which is the drop across the 100Ω resistor with no current applied through it. This value is the checkpoint reading and is stored in memory.

The output of the Current assembly is reconnected to the 100Ω resistor. Next, the DAC assembly, which is the Current input, is adjusted until the adc circuit measures the same reading as the check point.

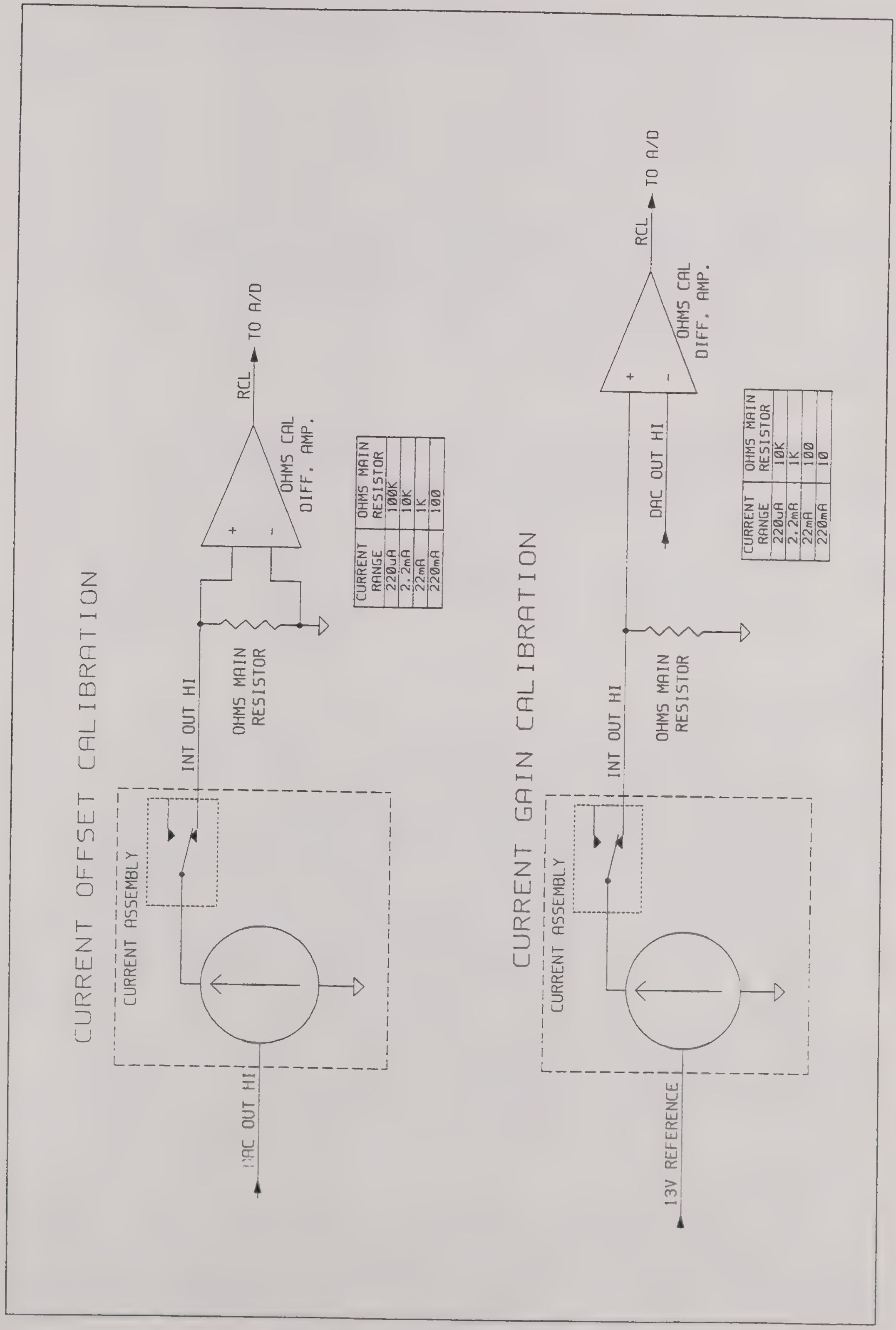
Gain is determined by connecting the input of the Current assembly to the 13V reference BRF13 and BSRF13 via relay K1 and analog switch U5B. The resulting 130 mA from the Current assembly is routed via INT OUT HI to a previously calibrated 10Ω resistor on the Ohms Main assembly. The +input of the differential amplifier, located on the Ohms Cal assembly, is connected to one side of this 10Ω resistor and the -input of the differential amplifier is connected to the output of the DAC assembly. The output of the differential amplifier is connected to the adc circuit in the DAC assembly via the RCL line, and the DAC output is adjusted until a null is achieved. This determines the exact voltage drop across the 10Ω resistor. The exact gain can now be calculated using this and the previous offset reading.

The current output, now calibrated at dc, is further characterized for its frequency response. The Current assembly is configured to the ac current function with input from the Oscillator Output assembly (A13) set to 20V at a low frequency. The output side of the appropriate shunt resistor is connected to SCOM by relay K17B, and the resulting 2V on the input side of the shunt resistor is connected to the AC CAL line through U22 by relay K17A. The AC CAL signal is routed to the Oscillator Control assembly (A12) where a 400Ω rms sensor measures the ac voltage on this line. A dc reading of the sensor is taken. It and the Oscillator Output level are stored in memory. The Oscillator Output frequency is then increased and the Oscillator Output level is adjusted, and stored in memory, so the dc reading from the rms sensor is the same as the previous reading. This is repeated at various frequencies up to 10 kHz to characterize the entire frequency response of the ac current output.

HIGH-RESOLUTION OSCILLATOR SECTION 2-199.

The High-Resolution Oscillator supplies a square-wave signal (HI-RES) in the range of 10 Hz to 1.2 MHz with a frequency resolution of 4 1/2 digits. The output signal is routed on the motherboard P LOCK HI line to the Oscillator Output assembly, where it phase-locks the oscillator.

During calibrator operation using an external phase-lock signal, or during a non-ac operation, the Hi-Res Oscillator is shut off by control line HI RES ON/OFF from the digital control circuit. The hi-res circuitry uses a phase-locked loop circuit containing the reference frequency amplifier/divider, phase detector/divider, loop filter, and vco circuit as outlined on the schematic. A 5-500k divider and output switching circuitry creates the final output frequency. These circuits are described in the following paragraphs.



CURRENT RANGE	OHMS MAIN RESISTOR
220uA	100K
2.2mA	10K
22mA	1K
220mA	100

CURRENT RANGE	OHMS MAIN RESISTOR
220uA	10K
2.2mA	1K
22mA	100
220mA	10

Figure 2-36. Current Assembly Calibration

The Hi-Res Oscillator output is divided into five ranges as shown below:

- 10.00 Hz to 119.99 Hz
- 0.1200 kHz to 1.1999 kHz
- 1.200 kHz to 11.999 kHz
- 12.00 kHz to 119.99 kHz
- 0.1200 MHz to 1.1999 MHz

Note that the frequency resolution on each range changes from four digits for outputs of 12 to 99 to five digits for outputs of 100 to 119. For example, the output of range 1 has four digits of resolution from 10.00 Hz to 99.99 Hz and five digits resolution from 100.00 Hz to 119.99 Hz. The range 2 output has four digits resolution from 120 Hz to 990 Hz and five digits resolution from 1000.0 Hz to 1.1999 kHz. The resolution break points are similar for the other ranges.

Reference Frequency Amp/Divider 2-200.

A 2-MHz reference frequency is generated by the reference frequency amp/divider circuit as outlined on the schematic. This circuit uses the 8 MHz system clock lines CLK and CLK*, generated by the Guard Crossing assembly (A17). This 8 MHz signal is a low-level clock (200 mV p-p) and it is amplified to 5V p-p by comparator U13A. This 5V 8 MHz clock is turned off when the Hi-Res Oscillator is not being used by control line HI-RES ON/OFF from the digital control circuit and nor gate U15D. The 8 MHz clock is then divided to 2 MHz by flip-flops U14A and U14B to generate 2 MHz REF, which is the reference frequency for synthesizer IC U16. It is filtered by R63 and C49 to generate HI-RES CLOCK, which is monitored by the diagnostic circuit.

Phase-Locked Loop 2-201.

The phase-locked loop circuit contains the phase detector/dividers, loop filter, and vco (voltage-controlled oscillator) circuits as outlined on the schematic.

The phase det/dividers circuit contains synthesizer IC U16. This IC contains two programmable divide-by-n counters and a phase detector. The divide-by-n counters are controlled by inputs from the control bus, which are latched into internal latches on the IC. Information on the control bus is entered and latched into U16 by NOR gate U15A and control lines CS7* and WR*. The first divide-by-n counter is programmed to divide 2 MHz REF by 2000 to give 1 kHz, which is applied to one input of the internal phase detector. The other divide-by-n counter is used to divide the feedback frequency at pin 3, which is generated by the VCO circuit, by 6.010 to 12.000 in one-digit steps, and then apply it to the second input of the phase detector. The loop is locked when the two inputs to the phase detector are the same frequency and phase.

With the 1-kHz reference frequency and the feedback divider programmed between 6.010 and 12.000, the input frequency at pin 3 of U16 must be between 6.010 MHz and 12.000 MHz (1 kHz x 6010 = 6.010 MHz and 1 kHz x 12000 = 12.000 MHz).

Phase detector (U16) outputs ("0V" on pin 14 and "0R" on pin 15) are used by the loop filter circuit, which controls the VCO circuit. If the divided feedback frequency is greater than the 1 kHz reference frequency, or if the phase of the divided feedback frequency is leading the output, 0V pulses low and output 0R remains high. If the divided feedback frequency is less than the 1 kHz reference frequency, or if the phase of the divided feedback frequency is lagging the output, then 0R pulses low and output 0V remains high. When the feedback frequency and the 1 kHz frequency are the same and in phase, the outputs 0V and 0R both remain high except for a short period when both pulse low in phase. This condition occurs when the loop is locked.

Outputs from the phase detector (0V and 0R) are connected to the loop filter circuit which contains the two op amps in U20. U20A and U20B amplify and filter, respectively, any phase difference and apply it to varactor diode CR9 in the vco circuit.

The vco circuit contains varactor diode CR9 and vco IC U19. The vco frequency is controlled by CR9, which gets its bias voltage from amplifier U20. This circuit is designed to always operate over a 2:1 range from 6 MHz-12 MHz. To lock the loop, amplifier U20 changes the bias on varactor diode CR9 until the divided vco frequency has the same frequency and phase as the 1 kHz reference frequency at the input to the phase detector in U16. Once the loop is locked, the output of the phase-locked loop circuit is between 6 and 12 MHz. This output frequency is connected to the 5-500k divider circuit for further division.

Supply voltage is applied to vco U19 whenever the Hi-Res function is used by the circuitry containing analog CMOS switch U18A, transistor Q15, and zener diode VR3. VCO U19 is energized when control line HI-RES ON/OFF goes low to close U18A, which turns on transistor Q15, connecting zener diode VR3 to the -17LH power supply.

R53 and R54 divide the bias voltage input of the vco circuit to generate the HI-RES LOOP line, which is monitored by the diagnostic circuit.

5-500K Output Divider 2-202.

The 5-500k output divider circuit contains a synthesizer IC U17 which has a reference (R) divider and a divide-by-N counter. These dividers are controlled by inputs from the CONTROL BUS, which are latched into internal latches on the IC. Information on the CONTROL BUS is entered and latched into U17 by NOR gate U15B and control lines CS13* and WR*. With the phase-locked loop output frequency locked at any frequency between 6 MHz and 12 MHz, divider U17 is programmed to divide by a value between 5 and 500,000 as required to produce the correct output frequency. The 6 MHz - 12 MHz input from the phase-locked loop circuit is divided by the reference divider to generate the 24 kHz-2.4 MHz frequency range at pin 18. This divided reference frequency is connected to pin 3, which is the input of the divide-by-N-counter. The divide-by-N counter further divides the signal to generate the 20 Hz-24 kHz frequency range at pin 15.

As an example, an output of 6.7 kHz is in range 3 with the loop locked at 6.7 MHz. (The internal divider in U16 is programmed to divide by 6,700, resulting in 6.700 MHz.) The two dividers in U17 are programmed for a total division of 500 (6.7 MHz/500 = 13.4 kHz). This 13.4 kHz signal is divided in half by the output switching circuit to generate the 6.7 kHz output.

Hi-Res Output Switching 2-203.

The output switching circuit contains three analog CMOS switches in U18, and flip-flops in U21. Flip-flop U21A divides the reference divider output of U17 by two to create the 12 kHz-1.2 MHz range. Flop-flop U21B divides the divide-by-N counter output of U17 by two to create the 10 Hz-12 kHz range. Control line HI-RES RANGE and NOR gate U15C control the analog CMOS switches U18B and U18C. These switches select the 12 kHz-1.2 MHz or the 10 Hz-12 kHz frequency range, respectively, from the flip-flops. Control line HI-RES ON/OFF and switch U18D connect this output square-wave signal to the P LOCK HI line when the variable phase output function is activated by the operator.

Table 2-16 shows how the dividers are set, the total division of the vco frequency, and the vco frequency. To determine the exact vco frequency, multiply the calibrator output frequency by the number in the total division bracket. For example, the output frequency is set to 42 kHz and the vco frequency is 42 kHz x 200 = 8.4 MHz. Note that the total division includes division by two by U21 in the output switching circuit.

Rear Panel Assembly (A21) 2-204.

Functional circuitry on the Rear Panel assembly includes a relay control circuit, phase lock in/variable phase out I/O circuit, address mapping, clock regeneration circuit, IEEE-488 interface, RS-232-C interface, interfaces for the 5205A, 5215A, and 5220A amplifiers, and a 5725A Amplifier interface. Three amplifiers can be physically connected to the 5700A: 5725A, 5220A with 5205A, or 5220A with 5215A). Only one can be used at a time. Depending on the amplifier's mode of operation, the output of the 5700A is either an ac or a dc voltage. The following theory of operation describes each of these circuits.

REAR PANEL POWER SUPPLIES 2-205.

Power supplies are divided into guarded and unguarded. Unguarded supplies +5V LOGIC, +12V, and -12V are referenced to +5V LOGIC COMMON and are generated

Table 2-16. Divider Settings and VCO Frequencies

CALIBRATOR OUTPUT FREQUENCY AT TP16	U17 R DIVIDER SETTING	U17 N DIVIDER SETTING	TOTAL DIVISION OF VCO AT TP13	VCO FREQUENCY AT TP13
10 Hz to 12 Hz	500	1000	1M	10 MHz to 12 MHz
13 Hz to 15 Hz	400	1000	800k	10.4 MHz to 12 MHz
16 Hz to 30 Hz	200	1000	400k	6.4 MHz to 12 MHz
31 Hz to 60 Hz	100	1000	200k	6.2 MHz to 12 MHz
61 Hz to 120 Hz	50	1000	100k	6.1 MHz to 12 MHz
130 Hz to 150 Hz	400	100	80k	10.4 MHz to 12 MHz
160 Hz to 300 Hz	200	100	40k	6.4 MHz to 12 MHz
310 Hz to 600 Hz	100	100	20k	6.2 MHz to 12 MHz
610 Hz to 1.2 kHz	50	100	10k	6.1 MHz to 12 MHz
1.3 kHz to 1.5 kHz	400	10	8k	10.4 MHz to 12 MHz
1.6 kHz to 3.0 kHz	200	10	4k	6.4 MHz to 12 MHz
3.1 kHz to 6.0 kHz	100	10	2k	6.2 MHz to 12 MHz
6.1 kHz to 12 kHz	50	10	1k	6.1 MHz to 12 MHz
13 kHz to 15 kHz	400	0	800	10.4 MHz to 12 MHz
16 kHz to 30 kHz	200	0	400	6.4 MHz to 12 MHz
31 kHz to 60 kHz	100	0	200	6.2 MHz to 12 MHz
61 kHz to 120 kHz	50	0	100	6.1 MHz to 12 MHz
130 kHz to 150 kHz	40	0	80	10.4 MHz to 12 MHz
160 kHz to 300 kHz	20	0	40	6.4 MHz to 12 MHz
310 kHz to 600 kHz	10	0	20	6.2 MHz to 12 MHz
610 kHz to 1.2 MHz	5	0	10	6.1 MHz to 12 MHz

on the Digital Power Supply assembly (A19). Guarded supplies +5LH and -5LH are referenced to LH COM, and the supply +5RLH is referenced to RLH COM. These supplies are generated on the Regulator/Guard Crossing assembly (A17). Some ICs on the A17 assembly do not have power and ground pins shown on the schematic. This information is included in the table on sheet 1 of the Rear Panel schematic.

REAR PANEL ADDRESS MAPPING 2-206.

The rear panel decodes address lines from the bus connected to the main CPU through connector P91. Decoding is accomplished with a C22V10 PLD (U8) with the following chip selects:

- RPDUARTCS*, D00000-D0001F
- RPIEEECS*, D00020-D0002F
- Y52XXRD*, D00030-D00031
- Y5205WR*, D00032-D00033
- Y5220WR*, D00034-D00035

CLOCK REGENERATION CIRCUIT 2-207.

In order to minimize EMI (electro-magnetic interference) inside the 5700A chassis, the rear panel accepts a low-level (~200 mV p-p sinewave) 3.68 MHz clock from the CPU assembly and conditions it to proper TTL clock levels.

This is done by a differential amplifier, U18, which amplifies the incoming signals 3.6864MHZCLK and 3.6864MHZCLK*. The output of U18 is a TTL level 3.68 MHz clock called RP3.68MHZ that is buffered by PLD U8 creating RPCLK for use by DUART (dual universal asynchronous receiver/transmitter) U5, and IEEE interface IC U2.

IEEE-488 (GPIB) INTERFACE 2-208.

The IEEE-488 (GPIB) interface circuit provides the interface between the IEEE-488 connector (J1) and the calibrator processor on the CPU (A20) assembly. The circuitry uses a TMS9914 (U2) General Purpose Interface Bus (GPIB) adapter to meet the requirements for talker/listener operation on the IEEE-488 bus. This circuit translates asynchronous 8 bit data and control information, under control of an external controller, and converts this information to an acceptable format for the CPU. responds.

The TMS9914 has internal circuitry which handshakes in the proper GPIB protocol and stores data in an internal buffer. This IC also has the capability of interrupting the CPU. The CPU can then handle the interrupt through its own handler routine. The data lines between U2 and J1 are buffered by a 75160A (U3) data buffer, and the command lines are buffered by a 75162A (U4) command buffer. J1 is a standard IEEE-488 connector. The shell of this connector is tied to chassis ground for EMI/RFI shielding.

RS-232C INTERFACE 2-209.

The RS-232C interface circuit uses a 68C681 DUART (U5), a 1488 line driver (U6), and a 1489 line receiver (U7).

The DUART does the parallel to serial data conversion and provides two channels of serial RS-232C communication.

The first channel is available to RS-232C connector J2 to meet serial interface needs between the 5700A and the external world. The transmit line (*TXDA) is driven by U6D to TX of J2, pin 2. The receive line RX goes from J2, pin 3 through receiver U7C to the receive line *RXDA of the DUART.

The second channel is connected to the 5725A Amplifier interconnect connector (J7) to provide the 5725A digital control interface to the CPU assembly. Transmit line *TXDB is driven by U6B to B-SCT of J7, pin 18. Receive line B-SCR from J7, pin 17 goes through receiver U7B to the receive line *RCVB of the DUART. These lines are also connected to J10, pins 2 and 3, for internal software testing.

The DUART (U5) also has six input lines, four of which are used to monitor CTSA*, B-CINT*, CAL SWA*, and CAL SWB*. The CTS (clear to send) line from J2, pin 5 goes through receiver U7A becoming CTSA*. Line CAL SWA* comes from the rear panel CALIBRATION switch.

The B-CINT* input (5725A cable interlock) is a logic signal used to let the 5700A know that the interface cable to the 5725A Amplifier is connected and the 5725A is energized.

The DUART (U5) generates four output lines. The first, RTSA*, is driven by U6C to the RTS (ready to send) pin 4 of J2. The remaining three are used in the auxiliary amplifier interface logic circuit.

5220EN* is the output enable for octal latch U10. 5220ADIR* is the output enable for buffer U11. 5205EN* is the output enable for octal latch U9.

AUXILIARY AMPLIFIER INTERFACE 2-210.

The Auxiliary Amplifier interface connects the 5700A to a 5205A or 5215A Precision Power Amplifier or the 5220A Transconductance Amplifier. The connection to the 5205A or 5215A is closed loop while the connection to the 5220A is open loop.

Three amplifiers can be physically connected to the 5700A: 5725A, 5220A with 5205A, or 5220A with 5215A). Only one can be used at a time. Depending on the amplifier's mode of operation, the output of the 5700A is either an ac or a dc voltage.

Relays on the Switch Matrix assembly connect OUTPUT HI signal to B IN, SENSE HI to B FB, and INT SENSE LO to B SNSLO, the driving signals for the 5205A, 5215A, and 5220A Auxiliary Amplifiers. These signals are routed to the rear panel from the motherboard through connector J8 and an external cable. The 5205A and 5220A configurations are described later.

5205A INTERFACE 2-211.

The 5205A is a power amplifier with gain of -100 and a bandwidth of dc to 100 kHz. When the 5205A function is selected via the calibrator keyboard, the output of the calibrator is routed to connector J3 (pins 1, 9, 2, and 10) on the rear panel, which is closed-loop interfaced to the 5205A.

NOTE

Model 5215A is also compatible with the 5205A connector. The 5215A provides the same ac functions of the 5205A, but not the dc functions.

During this mode of operation, the calibrator is configured to the ac 11V range. Relay K1 is energized and relay K3 is set connecting B IN to 5205A INPUT HI, B FB to 5205A SENSE HI2, PA COM to 5205A INPUT LO, and B SNSLO to 5205A SENSE LO. Relay K4 is energized, connecting 5205A SENSE LO to 5205A SENSE L and 5205A SENSE HI to buffer amplifier U13. The output of buffer U13 is connected to K3 pin 9.

Relay K11 connects the 5205A voltage guard signal V-GRD2 to the 5700A voltage guard V GUARD.

In addition to the ac signal, the 5700A/5205A interface is composed of four control lines and logic power. +5V LOGIC provides logic power for the opto-isolators in the 5205A and +5V LOGIC COMMON provides the return. The rear panel data bus, 5205AEN*, and Y5205WR* are used by latches in U9 to create control lines CONTROL and OPERATE to connector J3, pins 14 and 15, respectively.

CONTROL, when asserted low, places the 5205A in the “5200 Control” mode and sets up the 5205A for commands. OPERATE, when asserted low, commands the 5205A to go into operate.

The 5205A generates STATUS and TRIP signals that are connected to buffer U12 where they are monitored, via the DATA BUS and control line Y52XXRD*, by the 5700A.

STATUS, when asserted low, indicates that the 5205A is in the operate mode. TRIP, when asserted low, tells the 5700A that the 5205A has experienced a fault or overload and is no longer in the OPERATE mode.

5220A INTERFACE 2-212.

The 5220A is a transconductance amplifier with a gain of one. Its output range is from 0 to 20A, thus its input voltage is from 0 to 20V.

When the 5220A is selected via the front panel, the output of the 5700A is routed to connector J4 on the rear panel, which is the interface to the 5220A.

The 5220A is designed to be operated with the 5700A in an open loop configuration. In this mode of operation, relays K2 and K3 are reset and relays K1 and K5 are energized.

This configuration ties B IN to B FB and connects them to 5220A INPUT HI. B SNSLO and PACOM are tied together and connected to 5220A INPUT LO. In this mode, the 5700A senses at the rear panel.

In addition to 5220A INPUT HI and 5220A INPUT LO, the interface between the 5700A and 5220A is composed of ten control lines.

Lines BD0-BD3 form a four-bit bidirectional data bus. Data from the 5220A is buffered and read on the DATA BUS by buffer U12 and control line Y52XXRD*. Data to the 5220A is generated from the DATA BUS by latches in U10 and control lines 5220AEN* and Y5220WR*. This data is buffered by U11 and controlled by 5220ADIR* before connecting to J4, pins 4, 12, 3, and 11.

Lines BC0, BC2, BC3, and BC6 form a four bit address bus. This address is generated from the DATA BUS by latches in U10 and control lines 5220AEN* and Y5220WR*.

The 5220A generates status lines ACK* and WR*, which are connected to buffer U12 where they are monitored, via the DATA BUS and control line Y52XXRD*, by the 5700A. ACK* is asserted low when a valid address is accepted by the 5220A. WR* is asserted low when its OK to read the 5220A status.

5725A INTERFACE 2-213.

The 5700A is designed to work in close connection with the 5725A Amplifier. The rear panel in this system provides relay switching for the 5725A signals. The 5725A performs the same functions as both the 5205A and 5220A amplifiers. All voltage outputs from the 5725A are routed back to the binding posts on the 5700A. All current outputs from the 5725A are sourced at the 5725A OUTPUT binding posts. You can configure the 5700A to also source all its current outputs through the 5725A OUTPUT binding posts for convenience.

Connector J8 and Cable 4406 interface all the 5700A I/O signals between the Motherboard and the rear panel. Connector J7 interfaces the 5700A to the 5725A Amplifier. The interface between these two connectors is accomplished through relays K1, K2, and K6-K9. Relays K6-K9 break all the I/O lines except B-SENSE HI, B-OUT HI, V-GUARD, and B-IGRD, and connect them all to V-GUARD when the 5725A is not in use.

During 5725A operation, relays K1, K2, K6, and K7 switch the 5700A analog signals B IN, B FB, B SNSLO, and PACOM to lines BOOST IN, B-FEEDBACK, B-SENSE LO, and BPA COM on connector J7.

High voltage output of the 5725A (B-OUT HI and B-SENSE HI) is connected to the 5700A Motherboard via cable 4406 where it can be switched to the 5700A binding posts by relays on the motherboard.

Relays K8 and K9 connect the 5725A current function lines I-RET, and B-CUR on connector J8 to B-IRTN, and B-CURRENT, on connector J7 when the 5725A is outputting 5700A current (<=2.2A). Line B-RCL is used during 5725A calibration. Line B-RCL on J7 is connected to J8 through relay K6. Line B-RCL is routed via the motherboard to the Current assembly (A7) where it is switched to the calibrator RCL line by a relay.

PHASE LOCK IN/VARIABLE PHASE OUT 2-214.

The Oscillator Output assembly (A13) can be phase locked to an external signal connected to the PHASE LOCK IN BNC connector J6. Relay K10B connects the shell of this BNC connecter to chassis ground through protection resistor R19 when the 5700A is on internal operation, or to P LOCK LO when the 5700A is phase locked to the external signal coming in on J6.

This incoming signal is called PHLK IN on the schematic. Relay K10A switches an external phase-lock signal from J6 to the input of Q1 and Q2. FETs Q1 and Q2 provide current limiting for PHLK IN. Signal P LOCK is routed to connector J8 where it is connected to the Oscillator Output assembly via the Motherboard.

Components CR1, CR2, VR1, VR2, R4, and R5 provide amplitude protection for the phase lock circuitry on the Oscillator Output assembly by limiting the amplitude of P LOCK.

The Variable Phase Out BNC connector (J5) is connected to P SHIFT and its shell is connected to PA COM by energizing relay K12. Signal P SHIFT is a fixed-amplitude variable phase signal generated by the Oscillator Output assembly (A13). Refer to the Oscillator Output assembly theory of operation for a detailed description on the generation of P SHIFT. Resistor R18 serves as overcurrent protection for the BNC shell connection on J5.

REAR PANEL RELAY CONTROL 2-215.

The relays on the Rear Panel assembly are used as the interfaces for the 5205A, 5215A, 5220A, or 5725A amplifiers, or for switching the PHASE LOCK IN and VARIABLE PHASE OUT signals.

The relay switching circuitry is under control of the guarded digital bus via connector J8. This guarded digital bus is generated on the Regulator/Guard Crossing assembly (A17).

The relay control circuitry is located on sheet 5 of the Rear Panel schematic. This circuit uses an 82C55 programmable peripheral interface (U14) and two relay drivers (U16 and U17) to control the 12 relays on this assembly and one relay (K12) on the Analog Motherboard. The 82C55 (U14), which is under control of the guarded digital bus via connected J8, has three ports generating 24 outputs.

Port A (PA0-PA7) provides the input lines for relay driver U16.

Port B (PB0-PB7) provides the input lines for relay driver U17.

PC0-PC2 of port C provides the CLEAR, STROBE, and OUTPUTENABLE lines for these relay drivers.

Relay Driver U16 controls two latching relays (K2 and K3) and four non- latching relays (K1, K4, K5, and K7). Relay driver U17 controls one latching relay (K6) and five non latching relays (K8-K12). Relay driver U17 also creates control line RLY12* (pin 13) which controls relay K12 on the Analog Motherboard assembly (A3).

REAR PANEL CPU INTERFACE 2-216.

The rear panel is interfaced to the CPU assembly (A20) via connector J8 on the rear panel. The CPU has:

- Five address lines (RPA1-RPA5) which comprise the ADDRESS BUS
- Seven control lines which comprise the CONTROL BUS
- A low-level 3.6864 MHz clock (CLOCK, CLOCK*)
- Eight data lines RPD0-RPD7

Interfacing between the Rear Panel data bus (D100-D107) and the CPU data bus (RPD0-RPD7) is done with a bus transceiver U1.

Wideband AC Module (Option -03) 2-217.

The Option -03 Wideband AC Module consists of the Wideband Oscillator assembly (A6) and the Wideband Output assembly (A5).

The wideband module operates in conjunction with the Oscillator Output assembly (A13), and provides calibrated output voltages in the range of 300 μV to 3.5V rms at frequencies of 10 Hz to 30 MHz, into a 50Ω load resistance. The output impedance of the assembly is 50Ω. It is designed to drive 50Ω loads. The output of this option connects to the Type "N" wideband connector on the 5700A front panel.

Theory of operation for the Wideband Oscillator assembly (A6) and the Wideband Output assembly (A5) follows under separate headings.

Wideband Oscillator Assembly (A6) 2-218.

The Wideband Oscillator assembly generates sine wave outputs in the range of 1.1 MHz to 30 MHz, (with two-digit resolution) at a nominal full scale output of 700 mV rms.

The frequency source is a ECL-level square wave with a frequency range of 1.1 MHz to 30 MHz, created in the phase-locked loop and divider circuit. The amplitude of this square wave is controlled by the WB AMPLITUDE CONTROL line, which is a DC signal from the Wideband Output assembly, and the circuitry contained in the amplitude control amplifier.

The resulting variable frequency and amplitude square wave is converted to sine wave by one of the five-pole filters. This variable frequency and amplitude sine wave is routed to the Wideband Output assembly via connector J1 and a 75Ω coaxial cable.

Wideband Oscillator Power Supplies 2-219.

The +5LH, -5LH, +17S, and -17S supplies are generated on the Regulator assembly and routed to this assembly via the motherboard.

The -5LH supply is buffered by L12 and C49, creating the -5F supply.

The +5LH supply is divided by R66 and R67 to create the +2.5 supply which is the reference voltage for comparators in U7, U10, and U11.

Zener diode VR1 and resistor R39 create the +12 supply from the +17S supply. Zener diodes VR4 and VR5, resistors R40 and R41, and diodes CR8 and CR9 create the -12, -11, and -9.5 supplies from the -17S supply. These are used throughout the Wideband Oscillator assembly.

Wideband Oscillator Digital Control 2-220.

The digital control circuit on the Wideband Output assembly creates control lines WB MUXA, WB MUXB, WB MUXC, WB FBS, and WB ON/OFF*. These lines are routed to the Wideband Oscillator via the motherboard.

Control lines WB MUXA, WB MUXB, and WB MUXC are inverted and level-shifted by comparators in U7 to create the control lines for multiplexer U6. They are also used by the filter-select circuitry.

In this circuit, WB MUXA, WB MUXB, and WB MUXC are decoded by U8 to generate four control lines, These are inverted and level-shifted by comparators in U10 and U11. The output of these comparators create 16-32MHz FILTER, 8-16MHz FILTER, 4-8MHz FILTER, 2-4MHz FILTER, 1-2MHz FILTER, and Q8/Q9 SELECT, which are used in the filter switch drive circuitry.

Control line WB FBS is inverted and level-shifted by a comparator in U10. This creates FILTER BAND SWITCH, which is also used in the filter selection circuitry. Control line WB ON/OFF* shuts down the 8 MHz clock generator and vco when the wideband module is not in use.

Phase-Locked Loop and Divider Circuit 2-221.

The phase-locked loop and divider circuit uses 8 MHz clock generator U15, synthesizer IC U1, amplifier U2, vco U3, and dividers in U4 and U5 to generate an ECL-level square wave from 1.1 MHz to 30 MHz.

The 8 MHz clock generator creates the 8 MHz reference frequency from the 8 MHz system clock lines CLK and CLK*, which is a low level (~200 mV p-p) 8 MHz sine wave generated on the Regulator/Guard Crossing (A17) assembly. Comparator U15 converts this sine wave into a TTL-level 8 MHz square wave to provide the reference frequency for synthesizer IC U1.

Synthesizer IC U1 contains two programmable divide-by-N counters and a phase detector. The divide-by-N counters are controlled by inputs from the guarded digital bus, which are latched into internal latches on the IC. NOR gates in U14 are used to gate the chip select (CS14) and write (WR) lines from the digital bus. This forms the strobe pulse necessary to latch the frequency data into the synthesizer IC.

The first divide-by-N counter is programmed to divide the 8 MHz reference by 160 to give 50 kHz. This, in turn, is applied to one input of the internal phase detector. The other divide-by-N counter is used to divide the feedback frequency at pin 3 by 80 to 160 in 1 digit steps, and then apply it to the second input of the phase detector. The loop is locked when the two inputs to the phase detector are the same frequency and phase.

With a 50 kHz reference frequency and the feedback divider programmed between 80 and 160, the input frequency at pin 3 (feedback frequency) must be between 4 MHz and 8 MHz. (50 kHz x 80 = 4 MHz and 50 kHz x 160 = 8 MHz.)

The frequency into U1 pin 3 is generated by the vco (U3) and dividers in U4 and U5. A flip flop in U4 divides the vco frequency by 2 and the binary counter in U5 further divides by 4 to give a total division of 8.

If the input to U1 pin 3 is between 4 MHz and 8 MHz, then the vco frequency before the divide-by-8 must be 32 MHz to 64 MHz.

The phase detector outputs (“0V” on pin 14 and “0R” on pin 15) of the synthesizer U1 are used by the amplifier (U2) to control the vco (U3). If the divider feedback frequency is greater than the 50 kHz reference frequency, or if the phase of the divider feedback frequency leads the output, then 0V pulses low while output 0R remains high.

If the divider feedback frequency is less than the 50 kHz reference frequency, of if the phase of the divider feedback frequency lags the output, then 0R pulses low and the output 0V remains high.

When the feedback frequency and the 50 kHz reference frequency are the same and in phase, the output 0V and 0R both remain high except for a small period when both pulse low in phase. This condition occurs when the loop is locked.

The vco frequency is controlled by varactor diodes, CR1 + CR2, which get their bias voltage from amplifier U2. Amplifier U2, which gets its input from the phase detector outputs (0V and 0R) of U1, changes the bias on varactor diodes CR1 and CR2 until the divided vco frequency has the same frequency and phase as the 50 kHz reference frequency at the input to the phase detector in U1.

Any phase difference is amplified by U2 and filtered by L6, C53, and C17 to bring the loop into lock.

The vco is shut off whenever the Wideband AC module is not in use. To shut off the vco control line WB ON/OFF* is set low and inverted by a comparator in U7 which then turns on Q3.

With transistor Q3 on, transistor Q2 is turned off which removes the -5V supply from the vco to stop the oscillation.

With the vco frequency between 32 and 64 MHz, U4 divides by 2 to give a symmetrical square wave of 16 to 32 MHz, which is the top octave range required for this assembly. Further division by two (pin 15), four (pin 13), eight (pin 4), and sixteen (pin 2) by binary counter U5 gives the other ranges required of 8 to 16 MHz, 4 to 8 MHz, 2 to 4 MHz, and 1 to 2 MHz.

Multiplexer U6, under software control via control lines WB MUXA, WB MUXB, WB MUXC, and comparators in U7, can be programmed to select which of the 5 ranges is needed to give the output frequencies of 1 to 32 MHz.

Amplitude Control Amplifier and X10 Wideband Amplifier 2-222.

The square wave output generated by the phase-locked loop and divider circuit (1-32MHZ OUTPUT) is connected to the amplitude control amplifier circuit.

This circuit uses transistor array U9 to form a differential gain-control amplifier. Gain of the amplifier is controlled by the dc signal AMPLITUDE CONTROL, connected to U9 pin 10.

DC signal AMPLITUDE CONTROL is generated by the thermal rms sensor amplitude control circuitry on the Wideband Output assembly (A5) and is discussed in that section.

The gain controlled square wave output of U9 (pin 6) is further amplified by the x10 wideband amplifier circuit. Transistors Q4, Q5, and Q6 are configured as an amplifier with a gain of ten. This amplifier raises the gain-controlled square wave to the level needed to drive output filters. The output of this circuit is a square wave with an amplitude between 1.4V p-p to 6.0V p-p.

Wideband Oscillator Filters 2-223.

Each of the five octave frequency ranges has a 5-pole filter to change the square wave input to a sine wave output with a nominal full scale output of 700 mV rms.

The filter switch drive circuit uses control lines from the filter select circuit (that contains transistor arrays U12 and U13) to provide the drive to properly turn on and off FETs and transistors in each of the filters.

The filter inputs and outputs are switched on by FETs and the filter output is applied to output driver Q7. The corresponding filter is selected automatically as each octave range is selected. The operation of the 16-32 MHz filter is described. The other four filters operate in a similar fashion.

The input FET Q101 is turned on via control line 16-32MHZ FILTER and a transistor in U13. This applies the signal FILTER INPUT from the X10 wideband amplifier to follower Q102. Transistor Q102 drives the filter that contains L102, L103, L104, C109 and C112. FET Q105 is turned on, in the same manner as FET Q101, to connect the sine wave output of this filter to FILTER OUTPUT. This is applied to output driver transistor Q7.

To obtain the required amount of filtering over the entire octave range, additional capacitors C110 and C111 are switched into the filter by PIN diodes CR102 and CR103 when operating below 70% of the full range (22 MHz in this case).

Diodes CR102 and CR103 are activated by turning on Q103 and Q104, respectively. Transistors Q103 and Q104 are turned on via control line Filter Band Switch and a transistor in U12.

Two additional FETs, Q8 and Q9, are used to isolate the 16-32 MHz filter and the 8-16 MHz filter, from the three other lower frequency filters, whenever the two high frequency filters are used. The isolation provided by FETs Q8 and Q9 eliminates both the input and output load capacity and circuit board capacity of the three lower frequency filters, so that follower Q6 can drive the high frequency filter input without distortion of the waveform. This also eliminates loading the filter outputs, which changes the filter frequency response.

WIDEBAND OUTPUT ASSEMBLY (A5) 2-224.

The Wideband Output assembly (A5) takes the sine wave signal from either the Wideband Oscillator assembly (A6) or the Oscillator Output assembly (A13), and amplifies it to a power level that drives 3.5V into a 50Ω load at the output.

The Oscillator Output assembly generates the sine wave signal from 10 Hz to 1.1 MHz, and the Wideband Oscillator assembly generates the sine wave signal from 1.2 MHz to 30 MHz. This provides a total frequency range of 10 Hz to 30 MHz.

The Wideband Output assembly contains a power amplifier circuit that increases the gain and/or power level of the input signal. Also contained on the assembly are a thermal rms sensor circuit necessary for amplitude control, the 50Ω attenuators needed to reduce the output level through all of the amplitude ranges, an overload control circuit, and digital control circuitry.

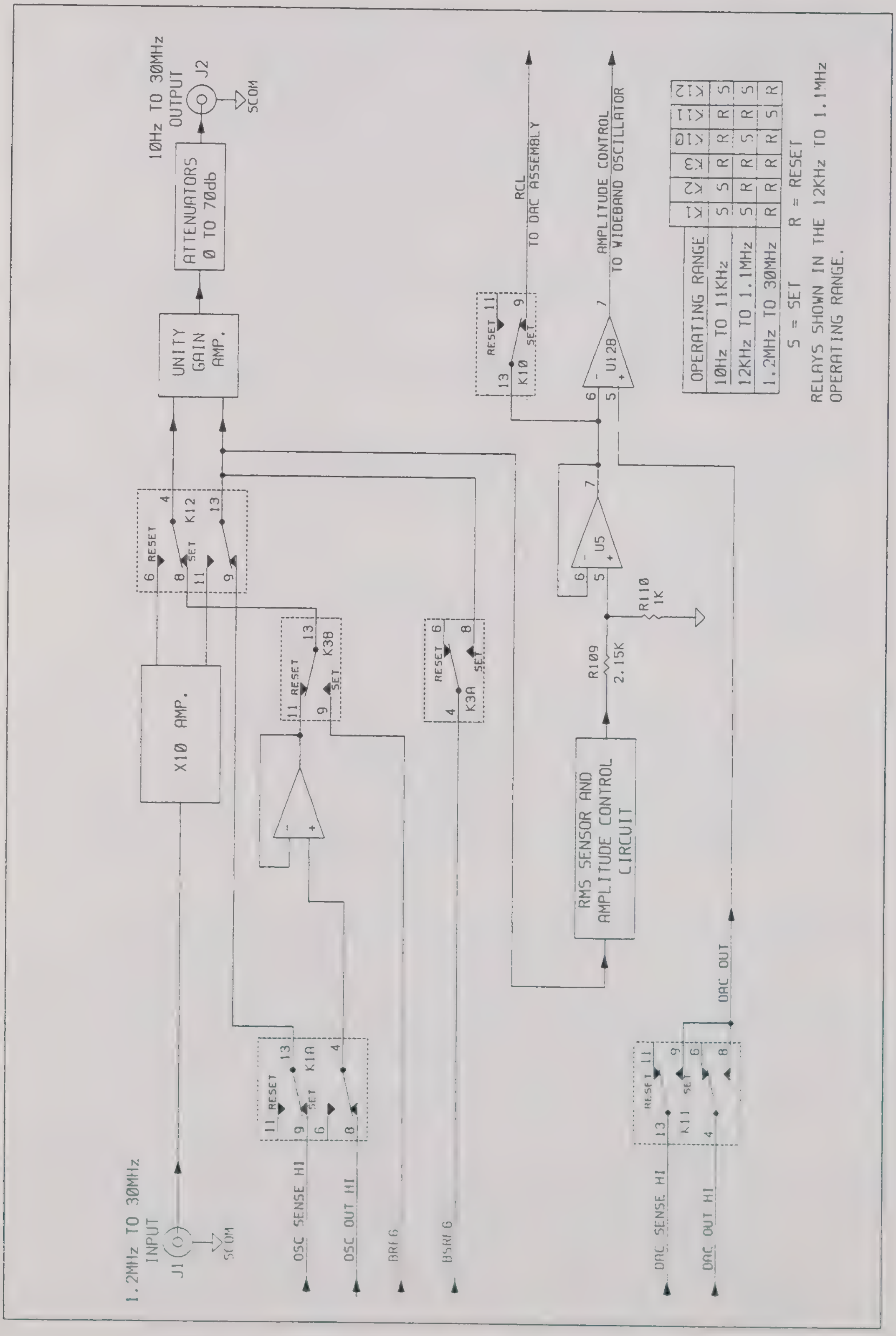
Figure 2-37 is a simplified schematic for the Wideband Output assembly.

The Wideband Output assembly has three basic operating ranges:

1. The first range is for Wideband AC module operation at frequencies between 10 Hz and 11.9 kHz. In this frequency range, relay K1A is in the set position so the input signal is from the Oscillator Output assembly with its amplitude is controlled by the Oscillator Control assembly (A12). The amplitude control circuit on the Wideband Output assembly is only used for overload protection. This is done by control line PB0 which goes high and turns on FETs Q2 and Q3 via comparator U4B. These FETs shunt the rms sensor's input and output to ground through 200Ω resistors (R2 and R18) to reduce the sensitivity of the sensor.

2. The second range is for operation at frequencies between 12 kHz and 1.1 MHz. In this mode the input signal is also from the Oscillator Output assembly, but the amplitude is controlled by the amplitude control circuit on the Wideband Output assembly. Relay K10 is in the set position to connect the output of the rms sensor and amplitude control circuit to the RCL line where it is measured by the adc circuit on the DAC assembly. The DAC assembly operates in conjunction with the Oscillator Control assembly to adjust the amplitude of the Oscillator Output signal.

3. The third range is for operation at frequencies between 1.2 MHz and 30 MHz. In this mode the input signal is from the Wideband Oscillator assembly via connector J1. Its amplitude is controlled by the amplitude control circuit on the Wideband Output assembly. In this mode, the output of the DAC assembly, DAC OUT HI and DAC SENSE HI, are connected to DAC OUT by relay K11 in the set position. Op amp U12B compares DAC OUT to the output of the rms sensor and amplitude control circuit. Any difference between these two signals is amplified and routed to the Wideband Oscillator assembly via the AMPLITUDE CONTROL line. The Wideband Oscillator uses the Amplitude Control line to adjust its AC amplitude until the sensor output is equal to the DAC voltage.



OPERATING RANGE	K1	K2	K3	K10	K11	K12
10Hz TO 11KHz	S	S	R	R	R	S
12KHz TO 1.1MHz	S	R	R	S	R	S
1.2MHz TO 30MHz	R	R	R	R	S	R

S = SET R = RESET

RELAYS SHOWN IN THE 12KHz TO 1.1MHz OPERATING RANGE.

Figure 2-37. Wideband Output Assembly Simplified Schematic

Wideband Output Power Amplifier Circuit 2-225.

The power amplifier circuit, as outlined on sheet 1 of the Wideband Output assembly schematic, contains all the circuitry shown on sheet 2 of the schematic. This circuitry consists of the x10 amplifier, the unity-gain amplifier, and the 10 Hz to 1.1 MHz buffer circuit as outlined on the schematic.

The x10 amplifier circuit is used only during operation in the 1.2 MHz to 30 MHz range. The 1.2 MHz to 30 MHz sine wave input comes from the Wideband Oscillator assembly via a coaxial cable and connector J1. This input signal has a nominal full-scale amplitude of 700 mV rms.

The x10 amplifier circuit uses transistors Q4, Q5, Q6, Q7, Q8, Q9, and Q10 to amplify this signal by a factor of 10. Amplifier U11A keeps the DC offset on the output to near zero. The output of the X10 amplifier is applied to the unity gain amplifier by relay K12 in the reset position. The output impedance of the unity gain amplifier is 50Ω, therefore the x10 amplifier must produce 7.0V rms to give 3.5V rms into the 50Ω load.

The 10 Hz to 1.1 MHz buffer circuit is used during operation in the 10 Hz to 12 kHz range or the 13 kHz to 1.1 MHz range. In this mode, the input signal comes from the Oscillator Output assembly. This input signal is buffered by Q17 and applied to relay K12. Amplifier U11B keeps the DC offset on the output near zero for the 10 Hz to 1.1 MHz range.

The unity-gain amplifier is connected to either the output of the x10 amplifier or the output of the 10 Hz to 1.1 MHz Buffer by relay K12. The unity gain amplifier uses transistors Q11-Q16 and associated components. This circuit increases the power to a level that drives 3.5V rms into a 50 ohm load. The four 1/2-watt resistors in parallel (R96, R97, R98, R99) along with the output resistance of the amplifier form the 50Ω output resistance.

The output of this amplifier, called 10HZ TO 30MHZ OUTPUT, is a sine wave with an amplitude between 1.1V and 3.5V rms into 50Ω. This output signal is used by the attenuators to provide the overall output range of the Wideband Output assembly. Resistors R41 and R42, and capacitor C23 divide this output signal to create OUTPUT OFFSET for diagnostics.

Wideband Output Attenuators 2-226.

The 10 Hz to 30 MHz sine wave signal output of the power amplifier circuit connects to the 50Ω output attenuator composed of attenuator networks Z1 and Z2 and relays K4, K5, K6, K7, and K8.

Relay K4 switches the 10 dB attenuator into the circuit when activated or bypasses it when not activated.

Relay K5 switches the 20 dB attenuator into the circuit when activated or bypasses it when not activated.

Relays K6 and K7 switch the 40 dB attenuator into the circuit when activated and bypas it when not activated. The attenuator can thereby reduce the signal level in 10 dB steps from 0 to 70 dB.

Power Amplifier output amplitude is continuously variable over a 10 dB range, which when combined with the 0 to 70 dB attenuator, gives a continuous output range of 300 µV to 3.5V rms.

When energized, relay K8 enables the output signal to be connected to the output coaxial connector J2.

Wideband Output RMS Sensor and Amplitude Control Circuit 2-227.

The rms sensor circuit is used for:

- Amplitude control
- Overload control over the frequency range of 12 kHz to 30 MHz
- Overload control only over the frequency range of 10 Hz to 12 kHz

The rms sensor and amplitude control circuit is composed of U1, U2A, U2B, U3, U5, U12A, U12B, and associated components. Thermal sensor U1 provides a dc voltage equal to the rms value of the input voltage (at pin 6).

Input voltage to the thermal sensor comes from the power amplifier circuit. DC voltage output from the thermal sensor is connected to U2A configured as an intergrator. The output of the intergrator is connected to a square-root amplifier configured by U2B U3, and U12A, which keeps the settling time of the sensor constant.

The dc output of this sensor circuit (available at TP1) is buffered by U5. In the 12 kHz to 1.1 MHz range, the output of U5 is connected to the RCL line by relay K10 in the set position. In the 1.2 MHz to 30 MHz range, the output of U5 is compared by U12B to DAC OUT.

The DAC assembly (A11) output, DAC OUT HI and DAC SENSE HI, are tied together by relay K11 to create DAC OUT.

Relay K2A connects capacitor C7 into the rms sensor circuit in the 10 Hz to 11 kHz range to add additional filtering for low frequency signals.

Wideband Output Overload Control Circuit 2-228.

The overload control circuit contains comparator U4 (A and B), FETs Q2 and Q3, transistor Q1, and associated circuitry. This circuit protects the rms sensor and attenuators during an overload condition. Comparator U4A detects an overload condition by comparing the dc output of the rms sensor against a reference voltage.

The reference voltage is determined by zener diode VR2 and resistor R21. If the dc output of the rms sensor reaches a voltage 10% greater than the normal full-scale voltage, the output of U4A goes negative. This negative voltage causes a positive voltage at the output of U4B which turns on FETs Q2 and Q3. These FETs protect the rms sensor from damage by shunting its input and output to ground through the 200Ω resistors R2 and R18.

The negative voltage at the output of U4A also turns off transistor Q1 and causes control line U9 ENABLE to go high. This disables relay driver U9, which turns off all attenuator relays (K4-K7) and output relay K8.

Wideband Output Digital Control 2-229.

The heart of the Wideband Output assembly digital control circuitry is a 82C55 programmable peripheral interface IC (U7), which is under software control via the guarded digital bus.

This IC has three ports, generating 24 outputs. These outputs control three relay drivers (U6, U9, U10) and a 4051 analog multiplexer IC (U8) for self diagnostics.

Port A (PA0-PA7) is used as a common input bus for the relay drivers. Relay driver U6 controls latching relays K1, K2, K10, K11, and K12. Driver U6 is enabled by PC3 and strobed by PC2. Relay driver U9 controls non-latching relays K4-K8. Driver U6 is strobed by PC0 and enabled by control line U9 ENABLE, which is generated in the overload control circuit. Relay driver U10 controls latching relays K3 and K9. It is strobed by PC1 and enabled by PC3.

Relays K1 and K12 are controlled by the same drive lines and, when in the set position, select the input from the Oscillator Output (A13) assembly during operation between 10 Hz and 1 MHz.

Relay K9 connects a 50Ω load (R43 and R44 in parallel) to the RCL line where the adc circuit on the DAC assembly can monitor the output voltage and thereby determine proper operation of the output attenuator resistors and relays.

The 4051 analog multiplexer IC (U8) is used by self-diagnostic routines for the Wideband AC module. This allows the 5700A to monitor three points on the Wideband Output assembly and one point on the Wideband Oscillator assembly. Points AMPLITUDE CONTROL, OUTPUT OFFSET, and SENSOR CAL are monitored on the Wideband Output assembly, and point PLL DIAGNOSTIC is monitored on the Wideband Oscillator assembly. PC4-PC6 of port C select which point the multiplexer monitors. PC7 enables the output of U8 to the SDL line where is is measured by the adc circuit on the DAC assembly (A11).

Wideband Output Calibration 2-230.

Linearity of the rms sensor is determined by configuring the Wideband Output similarly to the second range of operation as described earlier. A difference is that the Oscillator Output assembly operates at 1 kHz instead of between 12 kHz and 1.1 MHz during operating in this range.

The Oscillator Output is set to 2.5V at 1 kHz. The resulting dc voltage from the rms sensor is connected to the RCL line by relay K10 in the set position. The RCL line is routed to the +input of the adc circuit on the DAC assembly, and the adc -input is connected to the DAC output. The difference between the two is measured and stored in memory. The Oscillator Output is increased to 7.0V and the difference between the two adc inputs is again measured. Software uses these values to determine the linearity of the rms sensor.

The previously calibrated 6.5V reference BRF6 and its sense line BSRF6, from the DAC assembly is used to calibrate the 10 dB, 20 dB, and 40 dB attenuators.

Relays K3 A and B and K12 are in the set position. This connects the 6.5V reference to the unity-gain amplifier and the attenuators. Output at the WIDEBAND Type “N” connector is connected back to the OUTPUT HI SENSE and OUTPUT LO SENSE binding posts.

Attenuation is calibrated starting with 70 dB and decreased in 10 dB steps to 0 dB. The Switch Matrix assembly connects the output of the Wideband AC module to its internal cal zero amplifier circuit during all attenuator calibrations except the 0 dB and 10 dB. The internal cal zero amplifier circuit provides a gain of 10 to Wideband output during 20 dB to 70 dB attenuation calibration. The output of this amplifier is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. Output from the DAC is connected to the -input of the adc circuit and adjusted until a null is achieved. The exact attenuator value is then determined.

Section 3

Calibration and Verification

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INTRODUCTION 3-1.

This section gives procedures for 5700A calibration, verification, acceptance testing, and performance testing. Information here applies to testing the performance of and calibrating a normally operating 5700A. In case of malfunction, refer to Section 5, Troubleshooting, which explains how to use self diagnostic tests to identify a faulty module. Calibration and Performance Testing is presented in the following three parts:

- Calibration, which is to be done at the beginning of every calibration cycle. This is the same procedure as in Section 7 of the 5700A Operator Manual. It uses three external standards; 1Ω, 10 kΩ, and 10V dc. The procedure is repeated here for convenience. Also included in this part are procedures for doing Calibration Check and Range Calibration.
- Full Performance Verification, which is the full verification procedure, recommended every two years. Part of this procedure is Wideband AC Module (Option 5700A-03) flatness calibration, also recommended only every two years.
- Optional Tests, which are recommended following repair or for use in acceptance testing. These tests include such checks as load regulation, noise, and distortion. These tests are not required on a routine basis. They are not necessary after a 5700A passes Full Performance Verification.

CALIBRATION 3-2.

The following paragraphs cover the procedures for calibrating the 5700A to external standards, performing Calibration Check, and adjusting a range constant.

When shipped, your 5700A is calibrated at the factory, traceable to the U.S. National Institute of Standards and Technology (formerly National Bureau of Standards). All that is required to maintain traceability is calibration to external standards at the beginning of the calibration cycle and performance verification every two years. Calibration Check and Range Calibration are optional procedures that are available for special needs.

Additional information about 5700A calibration is contained elsewhere in the manuals:

- Section 1 of the Operator Manual describes the calibration process and the theory behind its use to establish traceability to national standards. Included in the same section is a description of the Calibration Check feature, and how you can use it to develop a performance history for your 5700A.
- Section 2 of the Service Manual contains detailed theory of operation.
- Section 4 of the Operator Manual explains how to do the very quick, automatic DC Zeros Calibration, which removes offsets on the 2.2V dc range.
- This section of the Service Manual contains a performance verification procedure that may be done every two years to maintain traceability. Part of this is Wideband AC Module (Option 5700A-03) flatness calibration.

Calibrating the 5700A to External Standards 3-3.

Calibration to external standards is required at the beginning of the calibration cycle. The cycle is selected in a setup menu as described in Section 4 of the Operator Manual (24 hours, 90 days, 180 days, or 1 year). To calibrate the 5700A, you apply three portable standards to the OUTPUT binding posts: a 10V dc voltage standard, a 1Ω resistance standard, and a 10 kΩ resistance standard.

You do not need to calibrate the 5700A in a tightly-controlled temperature environment. The recommended external standards and the 5700A have the ability to control or compensate for ambient temperature variations internally. During the procedure, the 5700A prompts you to input the ambient temperature. The 5700A retains this information for inclusion in specification readout and output shift reports.

When you finish calibration, but before you save the new constants, the 5700A presents you with the new changes as ± ppm and change as a percentage of specification for each range and function. You can print a list of changes through the serial (RS-232-C) port, or send the changes to a computer through either the serial port or the instrument control (IEEE-488) port. The 5700A displays the largest proposed change on the front panel.

NOTE

To establish the incoming tolerance condition of the 5700A, if any proposed change is greater than 70% of tolerance, the 5700A should be verified at that point using techniques and standards described in the Full Verification Procedure. If the greatest proposed change is less than 70%, the incoming condition may be considered to be in tolerance without further testing.

Table 3-1 lists the equipment required to calibrate the 5700A to external standards.

Proceed from the power-up state as follows to calibrate the main output functions to external standards:

1. Turn on the 5700A and allow it to warm up for at least 30 minutes.

NOTE

If the 5700A has been powered off in an environment outside of operating environment specifications, particularly with humidity above 70%, allow a minimum of two hours warmup.

2. Press the "Setup Menus" softkey then the "Cal" softkey. The calibration menu appears:

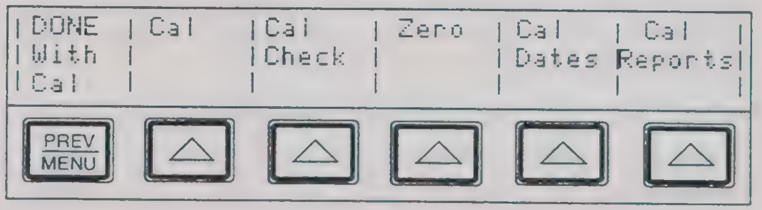
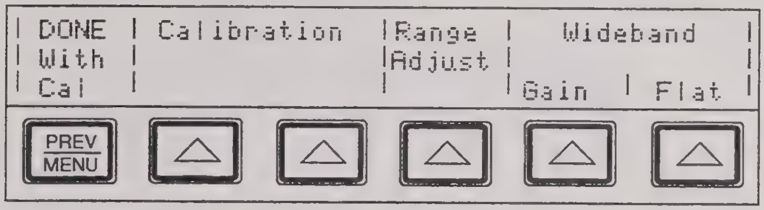


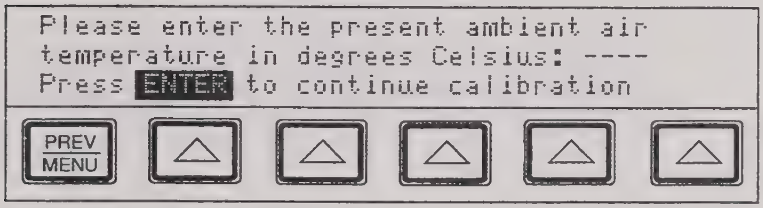
Table 3-1. Equipment Required to Calibrate the 5700A

EQUIPMENT	MODEL
DC Reference Standard	Fluke 732A
1Ω Resistance Standard	Fluke 742A-1
10 kΩ Resistance Standard	Fluke 742A-10k
Low Thermal EMF Test Leads, 2 ft (61 cm)	Fluke 5440A-7002
Type "N" to Dual-Banana Plug Adapter	Pomona 1740

3. Press the "Cal" softkey. The display changes to:

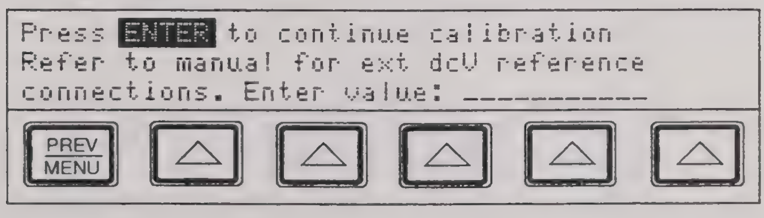


4. To calibrate the main output functions, press one of the softkeys under the "Calibration" label. The display changes to:



```
Please enter the present ambient air
temperature in degrees Celsius: ----
Press ENTER to continue calibration
```

5. Enter the ambient temperature, and press the ENTER key. The display changes to:

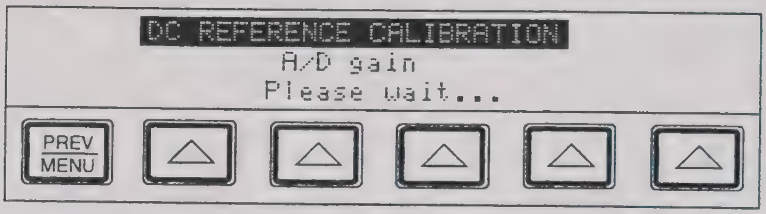


```
Press ENTER to continue calibration
Refer to manual for ext dcV reference
connections. Enter value: ___________
```

6. Connect the 10V reference standard to the 5700A as shown in Figure 3-1.

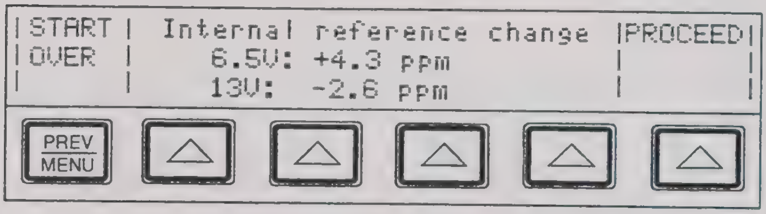
7. Enter the certified true value of the 10V reference standard.

   If the entered value is not between 9 and 11V, an error message appears which allows you to start again from this point with a calibrated 10V reference standard. After you press the ENTER key, the display changes to:



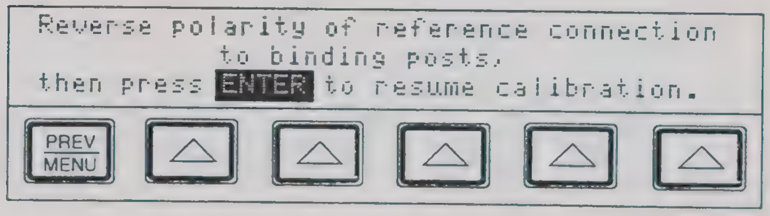
```
DC REFERENCE CALIBRATION
        A/D gain
     Please wait...
```

When the 5700A 6.5V and 13V references have been characterized, the following message appears, allowing you to accept or reject the changes about to be made to the calibration constants:



```
|START |  Internal reference change  |PROCEED|
|OVER  |     6.5V: +4.3 ppm          |       |
|      |     13V:  -2.6 ppm          |       |
```

8. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with the following message on the display:

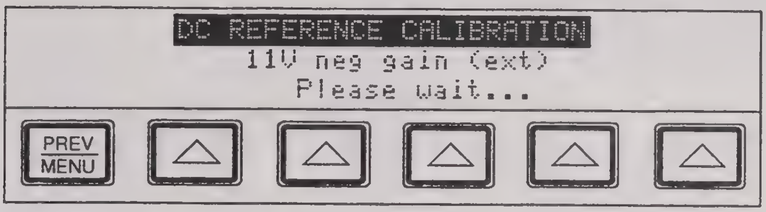


```
Reverse polarity of reference connection
          to binding posts,
then press ENTER to resume calibration.
```

NOTE

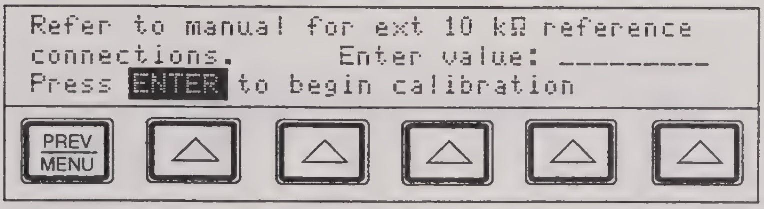
If there is leakage between the OUTPUT LO and GROUND terminals on the 10V reference standard, errors will occur in negative output calibration. Resistance of 20 MΩ or greater between the OUTPUT LO and GROUND terminals on the 10V reference standard indicates adequate isolation.

9. Reverse the HI and LO connections at the 10V reference standard terminals, and press ENTER. The display changes to:



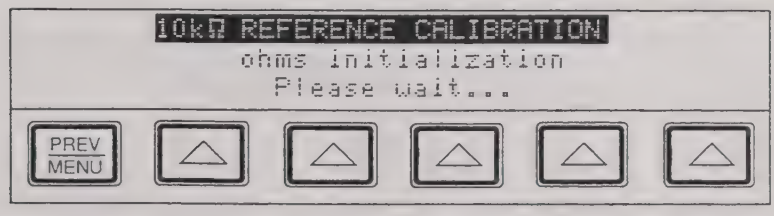
```
DC REFERENCE CALIBRATION
11V neg gain (ext)
Please wait...
```

10. When the display changes to:



```
Refer to manual for ext 10 kΩ reference
connections.      Enter value: _________
Press ENTER to begin calibration
```

Connect the 5700A to the 10 kΩ standard as shown in Figure 3-2 and enter the certified true value of the standard. If the standard is not between 9 kΩ and 11 kΩ, an error message appears, which allows you to start again from this point with another standard. When you press the ENTER key, the display changes to:



```
10kΩ REFERENCE CALIBRATION
ohms initialization
Please wait...
```

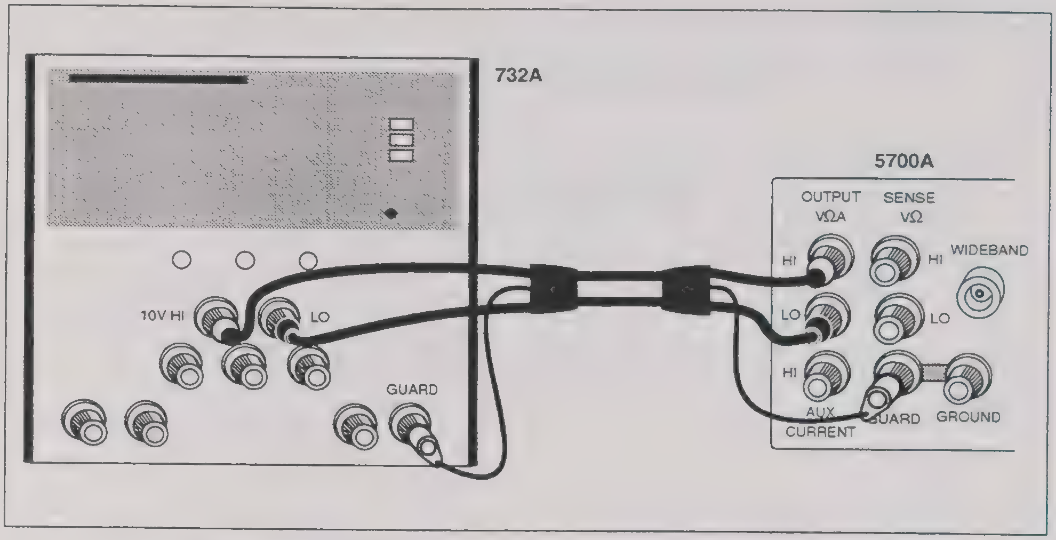


Figure 3-1. 10V Reference External Calibration Connections

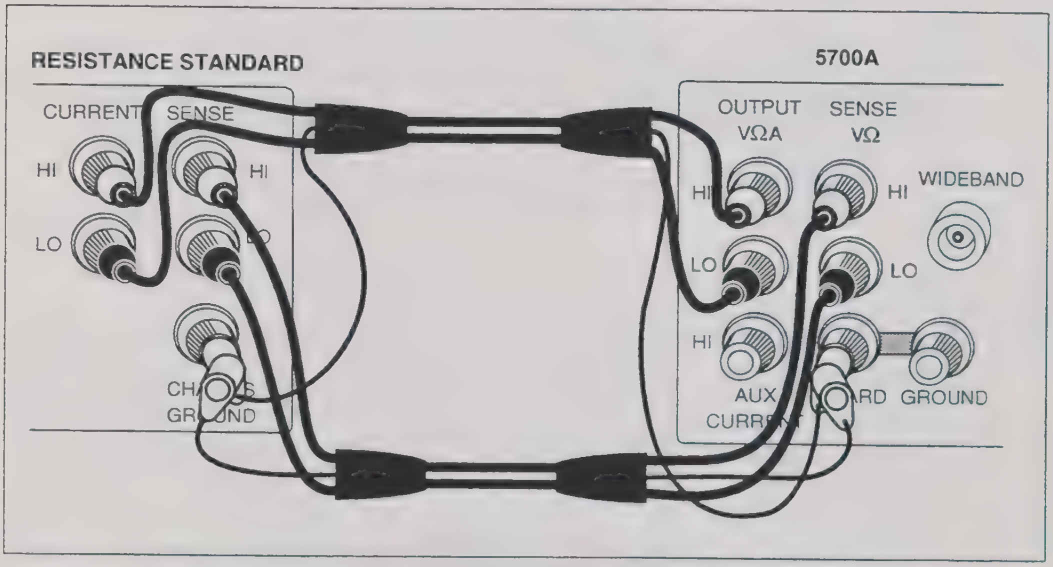
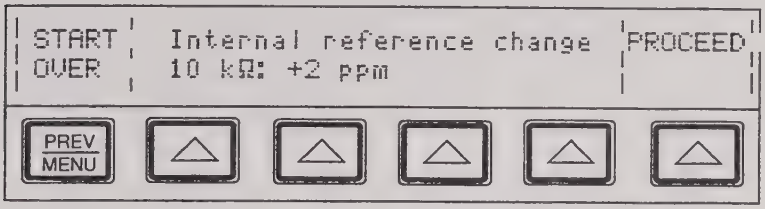


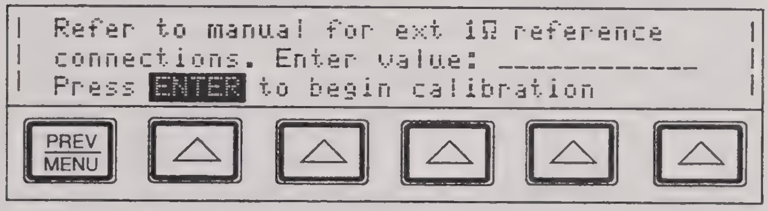
Figure 3-2. 742A-1 and 742A-10k External Calibration Connections

When the internal 10 kΩ reference has been characterized, the following message appears, allowing you to accept or reject the changes about to be made to the calibration constant:



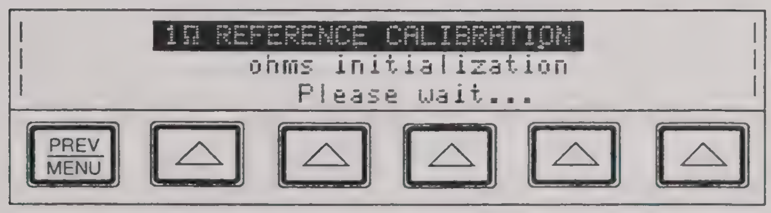
Internal reference change
10 kΩ: +2 ppm

11. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with the following message on the display:



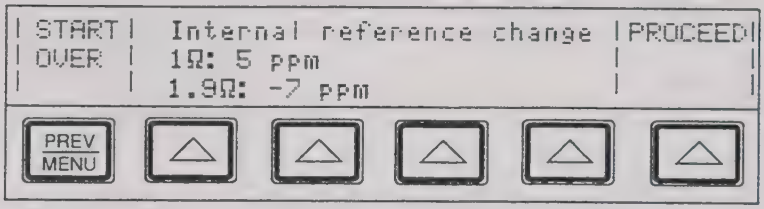
Refer to manual for ext 1Ω reference
connections. Enter value: ____________
Press ENTER to begin calibration

12. Disconnect the 10 kΩ standard, and connect the 5700A to the 1Ω standard the same way, then enter the certified true value of the 1Ω standard. If the standard is not between 0.9Ω and 1.1Ω, an error message appears which allows you to start again from this point with another standard. When you press ENTER, the display changes to:



1Ω REFERENCE CALIBRATION
ohms initialization
Please wait...

When the internal 1Ω reference has been characterized, the following message appears allowing you to accept or reject the changes about to be made to the calibration constant:



Internal reference change
1Ω: 5 ppm
1.9Ω: -7 ppm

13. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with internal-only calibration steps.
14. Calibration is not effective until you store the newly-calculated constants in memory. To store the constants, set the rear panel CALIBRATION switch to ENABLE, then press the "Store Values" softkey.

NOTE

You can print a listing of the proposed output shifts to review them before storing the new constants. To print the listing, press the "Print Output Shifts" softkey.

15. After you store the constants, press the "DONE with cal" softkey to exit the calibration menu and resume normal operation. If you press this softkey before storing the constants (up to Revision G Main software) the new constants will be used temporarily in place of the stored constants for normal operation until the instrument is powered down or the RESET key is pressed or *RST is sent over the remote interface. (Revision H and after) the process is aborted with out updating existing constants.
16. Set the rear panel CALIBRATION switch to NORMAL.

Wideband AC Module (Option 5700A-03) Calibration 3-4.

The Wideband AC Module (Option 5700A-03) requires two kinds of calibration: gain and flatness. Gain should be calibrated at the same time as routine calibration of the 5700A main output functions, or whenever the output cable or 50Ω feedthrough termination is changed.

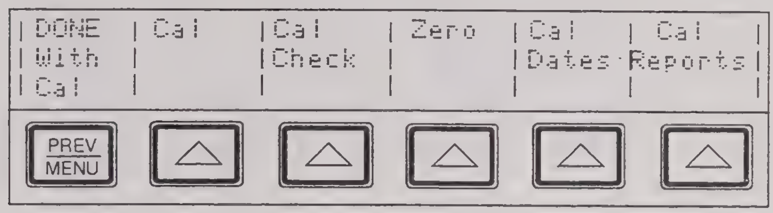
Because frequency flatness is determined by such stable parameters as circuit geometry and dielectric constants, flatness of the Wideband AC module has excellent long-term stability. This stability gives the Wideband AC Module a two-year calibration cycle for flatness calibration. Flatness calibration is required only infrequently, and can be done when the 5700A is returned to a standards laboratory for periodic verification. The full verification procedure, further on in this section, contains the wideband flatness calibration procedure. Presented here is the wideband gain calibration procedure.

You must calibrate the 5700A-03 Wideband AC option with the 50Ω termination and cable assembly that came with the option. Similarly, when returning a 5700A for calibration or service, you must also return the 50Ω termination and cable assembly so they can be calibrated with the Wideband option.

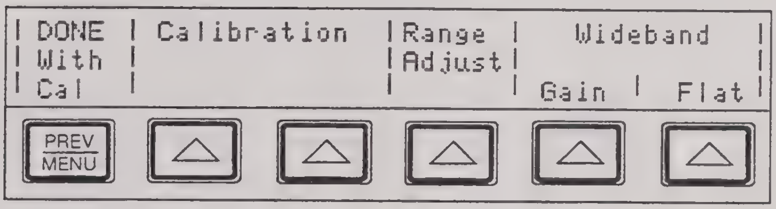
For wideband gain calibration, the only required equipment other than that supplied as standard equipment with the wideband option is a Type "N" female to dual banana plug adapter (e.g., Pomona 1740). Proceed as follows to calibrate wideband gain:

1. Verify that the 5700A has warmed up for at least 30 minutes.

2. Press the "Setup Menus" softkey then the "Cal" softkey. The calibration menu appears:



3. Press the "Cal" softkey. The calibration menu appears:



4. Connect the wideband output cable between the WIDEBAND connector and the SENSE binding posts with the center conductor of the 50Ω feedthrough going to SENSE HI as Figure 3-3 shows. The GND tab on the adapter should be on the LO side.

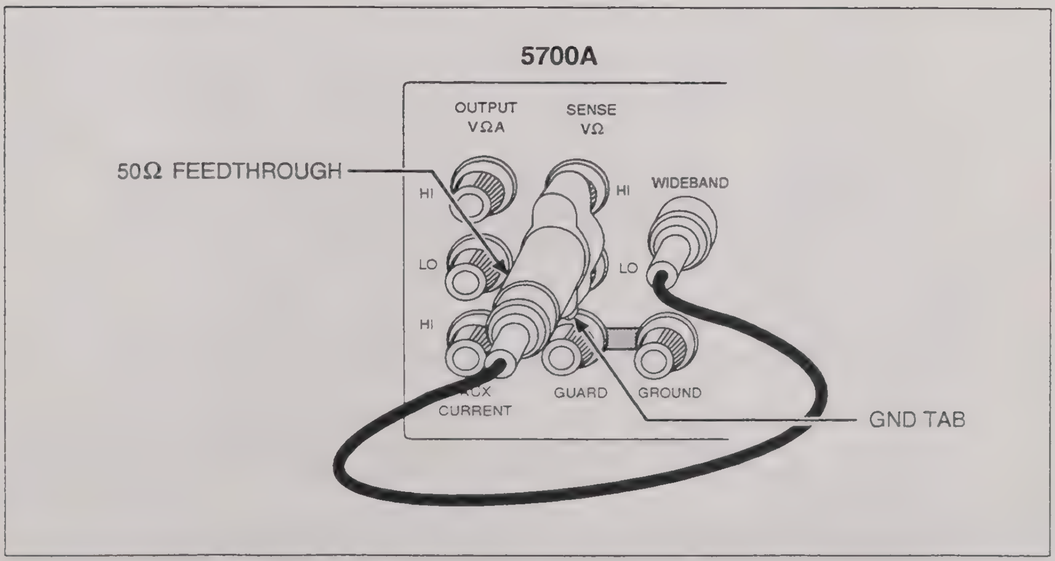
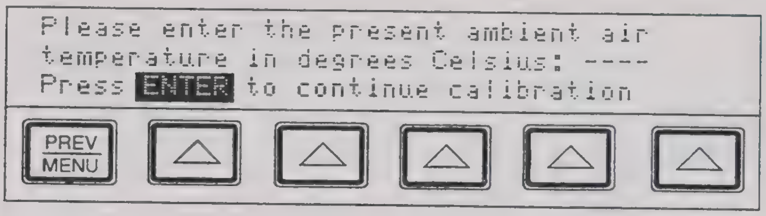


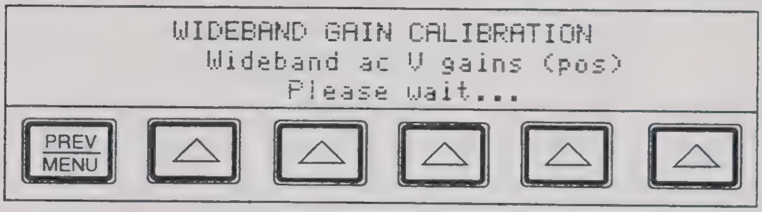
Figure 3-3. Wideband Module Calibration Connections

5. Press the “Gain” softkey. The display changes to:



```
Please enter the present ambient air
temperature in degrees Celsius: ----
Press ENTER to continue calibration
```

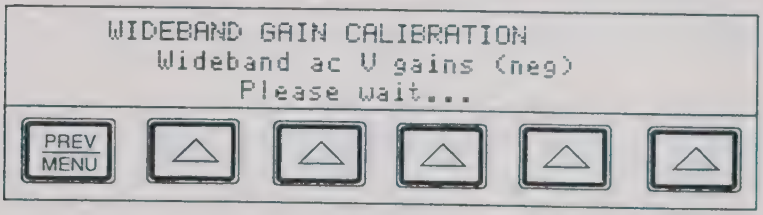
6. Enter the ambient temperature, and press ENTER. The display changes to:



```
WIDEBAND GAIN CALIBRATION
Wideband ac V gains (pos)
Please wait...
```

As wideband gain calibration proceeds, messages appear on the display identifying all processes as they are encountered. When positive gains calibration is complete, a message appears telling you to refer to the manual for negative gains connections.

7. Reverse the dual-banana connector so that the center conductor is connected to LO and press ENTER. The display changes to:



```
WIDEBAND GAIN CALIBRATION
Wideband ac V gains (neg)
Please wait...
```

After a brief time, a message announces that wideband gains calibration is complete.

8. To store the new constants, set the rear panel CALIBRATION switch to ENABLE and press “Store values”. If you do not wish to make wideband gains calibration effective, press “DONE with cal” and answer “YES” to the next display that asks for verification.
9. Calibration is finished. Set the rear panel CALIBRATION switch to NORMAL, disconnect the wideband cable, and press RESET.

Doing a Calibration Check 3-5.

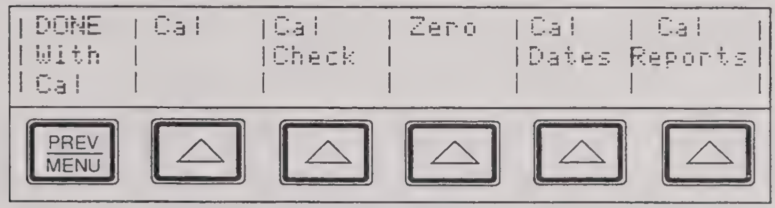
Calibration Check is similar to calibration to external standards except that no changes are made to stored constants, and the internal check standards are used as the reference points. Calibration Check produces a report similar to normal calibration, showing changes since last calibration to external standards. Because Calibration Check does not change stored calibration constants, there is no need to enable the rear panel CALIBRATION switch. The procedure can be done by an external computer, completely unattended. (See Section 5 for a Calibration Check remote program example.)

You can use Calibration Check at any time to confirm the integrity of the 5700A's state of calibration without having to connect external standards. You can also use Calibration Check as a powerful performance history gathering tool.

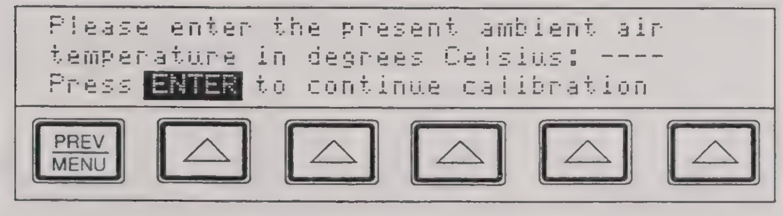
Proceed from the power-up state as follows to do a Calibration Check:

1. Turn on the 5700A, and allow it to warm up for at least 30 minutes.

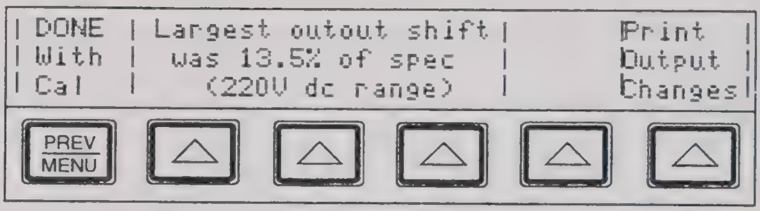
2. Press the "Setup Menus" softkey, then press the "Cal" softkey. The calibration menu appears:



3. Press the "Cal Check" softkey. The display changes to:


Please enter the present ambient air
temperature in degrees Celsius: ----
Press ENTER to continue calibration

4. Enter the ambient temperature and press ENTER. As Calibration Check proceeds, messages appear on the display identifying all processes as they are encountered. When the whole process is complete, the display shows the largest shift detected:



Largest outout shift
was 13.5% of spec
(220V dc range)

5. At this point you can print a listing of the shifts or you can quit. To return to normal operation, press the "DONE with check" softkey.

   To print a Calibration Check report, connect a printer or other peripheral and set up the serial interface as described in Section 6. Press the "Print Output Changes" softkey.

6. Press PREV MENU to exit the calibration menu.

Range Calibration 3-6.

After calibration, you can make further fine adjustments to each range if you wish by adjusting a range constant. This is called Range Calibration. A range constant is an additional gain multiplier for each range. Range adjustments are optional; they are not necessary to meet total uncertainty specifications. However, they do allow you to align the 5700A closer to your standards.

To adjust a range constant, you use your own laboratory standard. This procedure is designed to work for laboratory standard values that are greater than or equal to 45% of the range full-scale value and less than or equal to 95% of the range full-scale value. The new range constant is active until the next calibration event. Every time you calibrate the 5700A, all range constant multipliers are reset to 1. You can also erase all range adjustments by calling up the format EEPROM menu and selecting range constants. (See 5700A Operator Manual section 4.)

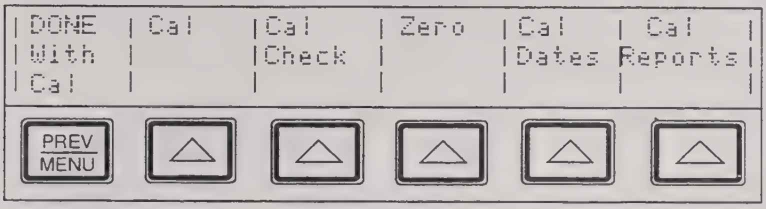
The procedure to adjust a range constant is menu driven, similar to normal calibration. Many different types of standards in many different configurations can be used for the different functions and ranges. For example, you can adjust the 220V dc range using the following equipment:

- 732A DC Reference Standard
- 752A Reference Divider
- 845AB/845AR Null Detector
- 5440B-7002 Low Thermal Test Leads (three sets)

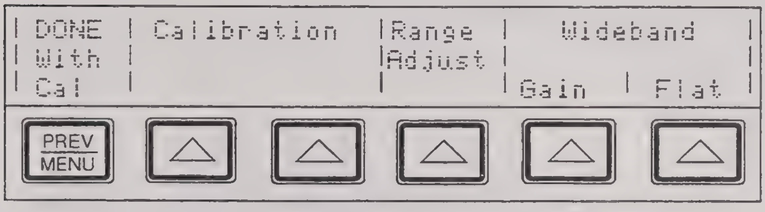
A procedure to adjust the 220V dc range constant using the above equipment is described here. You can use your own laboratory standards to adjust other range constants similarly.

Proceed as follows to adjust the 220V dc range constant:

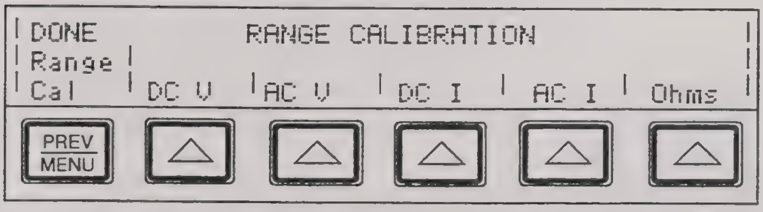
1. Perform calibration to external standards as described previously in this section.
2. Press the "Setup Menus" softkey, then press the "Cal" softkey. The calibration menu appears:



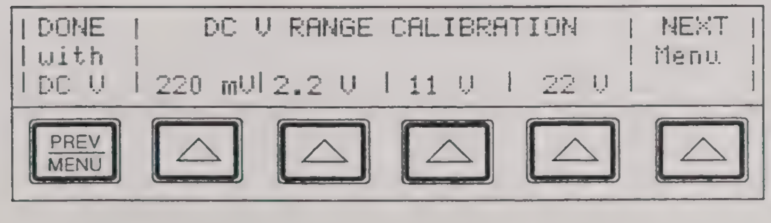
3. Press the "Cal" softkey. The display changes to:



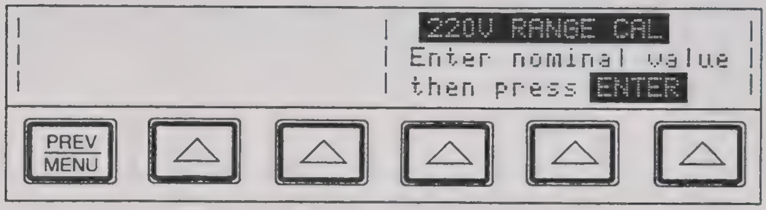
4. Press the "Range Adjust" softkey. The display changes to:



5. Press the "DC V" softkey. The display changes to:

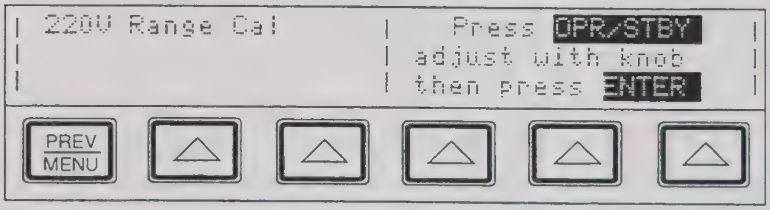


6. All the ranges for dc voltage are presented in a series of menus. Pressing the "NEXT Menu" softkey scrolls through the choices. Press "NEXT Menu" until "220 V" appears, then press its softkey.



220V RANGE CAL
Enter nominal value
then press ENTER

7. Connect the 732A, 845A, and 752A in a 10:1 configuration as Figure 3-4 shows.
8. Enter the value of the 732A multiplied by 10. (This is the output of the 752A to which you will null the output of the 5700A.) When you press ENTER, the display changes to:



220V Range Cal

Press OPR/STBY
adjust with knob
then press ENTER

9. Press OPR STBY to activate the calibrator output.
10. Rotate the 5700A output adjustment knob to achieve a null on the 845A Null Detector.
11. Set the rear panel CALIBRATION switch to ENABLE.
12. Press ENTER. This causes the 5700A to calculate a new range constant multiplier for the 220V dc range and store it in nonvolatile memory.
13. Range Calibration is complete. Set the rear panel CALIBRATION switch to NORMAL, disconnect the external standards, and press RESET.

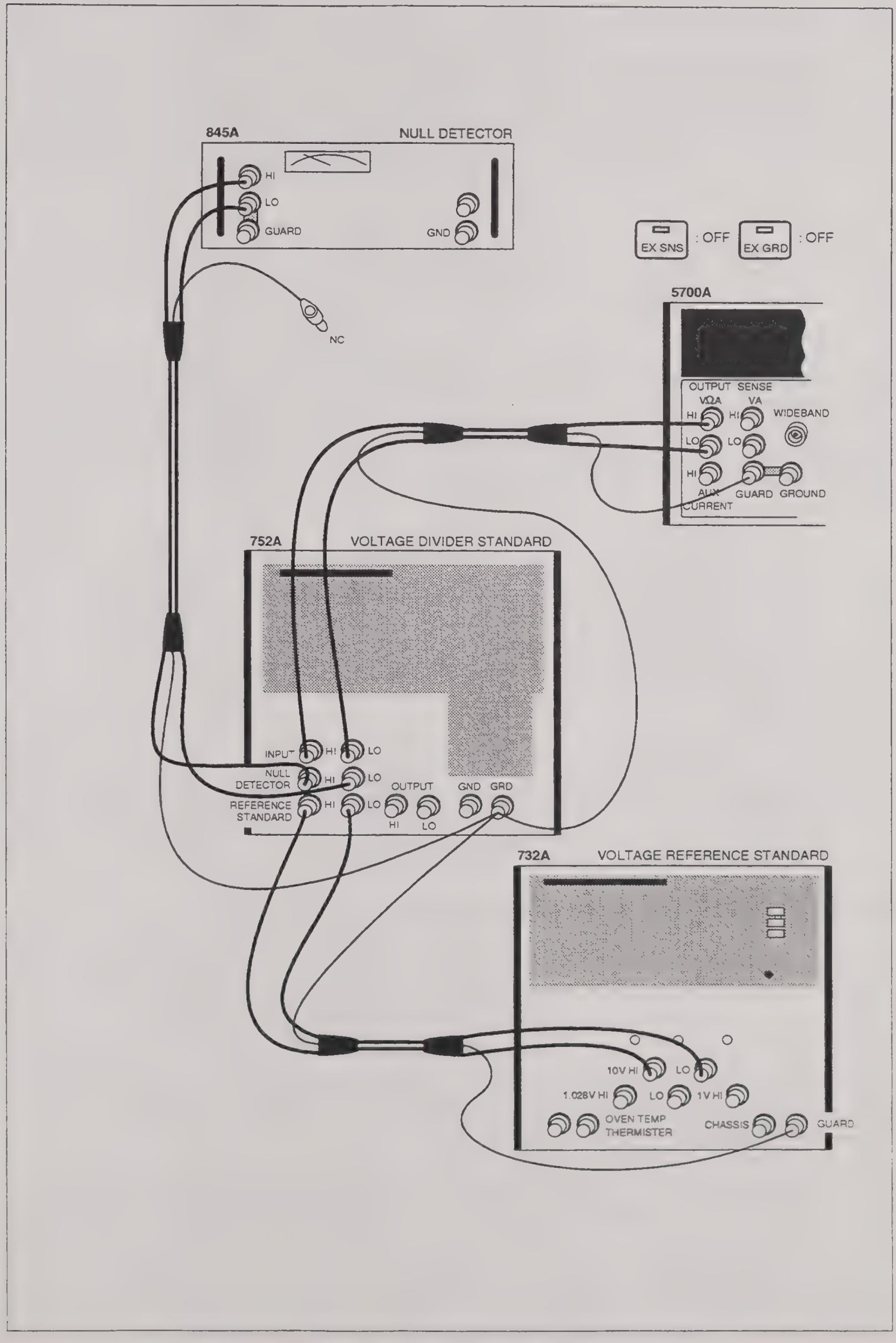


Figure 3-4. 220V DC Range Calibration Connections

FULL VERIFICATION 3-7.

An independent external verification is recommended every two years, following normal periodic calibration or repair of the calibrator. Verification establishes and maintains parallel external traceability paths for the internal functions that are not adjusted or corrected during calibration. An example is the internal ac/dc transfer standard. Verification also serves as a check that internal calibration processes are in control.

NOTE

All performance limits specified in the test records apply to 90-day specifications for the 5700A. If limits to other specifications are desired, the test records must be modified.

Before beginning verification, make copies of the test record (Table 3-33) located at the end of this section. Due to the state of the art performance of the 5700A, it is necessary to record test data for many of the tests for use as characterized values in subsequent tests. Many of the performance limits are shown only on the test record rather than in the body of the text. This allows an experienced technician to use the test record as an abbreviated version of the test procedure.

NOTE

Equivalent equipment and methods, either manual or automated, may be substituted for the following verification tests as long as the same points are tested, and equipment and standards used are at least as accurate as those specified. If standards are less accurate than specified, appropriate tolerance limit and/or accuracy reductions must be made to achieve equivalent results.

Required Equipment for All Tests 3-8.

An abbreviated summary of required equipment for all the verification and optional tests is given in Table 3-2. Individual lists of required equipment are included at the beginning of each test. For substitution information, refer to Table 3-32, Minimum Use Requirements, located near the end of this section.

Warmup Procedure For All Verification Tests 3-9.

Before performing verification, do the following preliminary steps:

1. Verify that the 5700A has warmed up for at least thirty minutes.

NOTE

If the 5700A has been powered off in an environment outside of operating environment specifications, particularly with humidity above 70%, allow a minimum of two hours warmup.

2. If you are doing a regularly scheduled full verification as recommended by Fluke, calibrate the 5700A as previously described before continuing with verification.
3. Ensure that each piece of external test equipment has satisfied its specified warmup requirements.
4. Ensure that the 5700A is in standby (STANDBY annunciator lit).

Table 3-2. List of Required Equipment for Main Output Tests

MFR.	MODEL	DESCRIPTION	APPLICATION
Fluke	742A Series	Resistance Standards	Cal, Ohms, DC
Fluke	752A	Reference Divider	DC V
Fluke	845A	Null Detector	DC V
Fluke	792A	AC/DC Transfer Standard	AC V
Fluke	5790A	AC Measurement	AC I
Fluke	5100B	Calibrator	Ohms
ESI	DT72A	Ratio Transformer	mV AC
Philips	PM6669	Frequency Counter	Frequency
Fluke	A40 Series	Shunts	AC I
Fluke	Y5020	High Current Shunt	DC I
L&N	0.1Ω	Resistance Standard	DC I
Fluke	8920A	RMS Wideband Voltmeter	2 mV AC
Fluke	8505A	DMM	Ohms, DC, AC, AC V
Fluke	P/N 853429	50Ω Feedthrough Termination	mV AC
Fluke	5440-7002	Low Thermal Cables	Various
EQUIPMENT REQUIRED FOR WIDEBAND AC MODULE (OPTION 5700-03) VERIFICATION			
MFR.	**MODEL**	**DESCRIPTION**	**APPLICATION**
Fluke	A55-3V	High Freq. Thermal Converter	Wideband
Narda	777C-20	20 dB RF Attenuator (Qty. 3)	Wideband
Narda	777C-10	10 dB RF Attenuator (Qty. 1)	Wideband
Comlinear	CLC100	20 dB Amplifier (Qty. 2)	Wideband
(Any)	(Any)	±12V Power Supply	Wideband
EQUIPMENT REQUIRED FOR OPTIONAL TESTS			
MFR.	**MODEL**	**DESCRIPTION**	**APPLICATION**
Tektronix	7000	Oscilloscope Mainframe	HF Noise
Tektronix	7A22	Differential Amplifier	HF Noise
HP	334A or 8903A	Distortion Analyzer	AC V, AC, Distortion
Tektronix	7L12	Spectrum Analyzer	AC V, Wideband Distortion
Fluke	720A	Kelvin Varley	DC V Linearity
Narda	777C-20	20 dB RF Attenuator(Qty. 3)	AC 2 mV Flatness

Table 3-3. Equipment Required for Resistance Testing

EQUIPMENT	DESCRIPTION
Resistance Standards	Fluke 742A Series in the following values: 1Ω 1.9Ω, 10Ω, 10 kΩ, 19 kΩ, 10 MΩ, and 19 MΩ
Current Source	Fluke 5100B, 5700A, or EDC CR103/J
DMM	Fluke 8505A

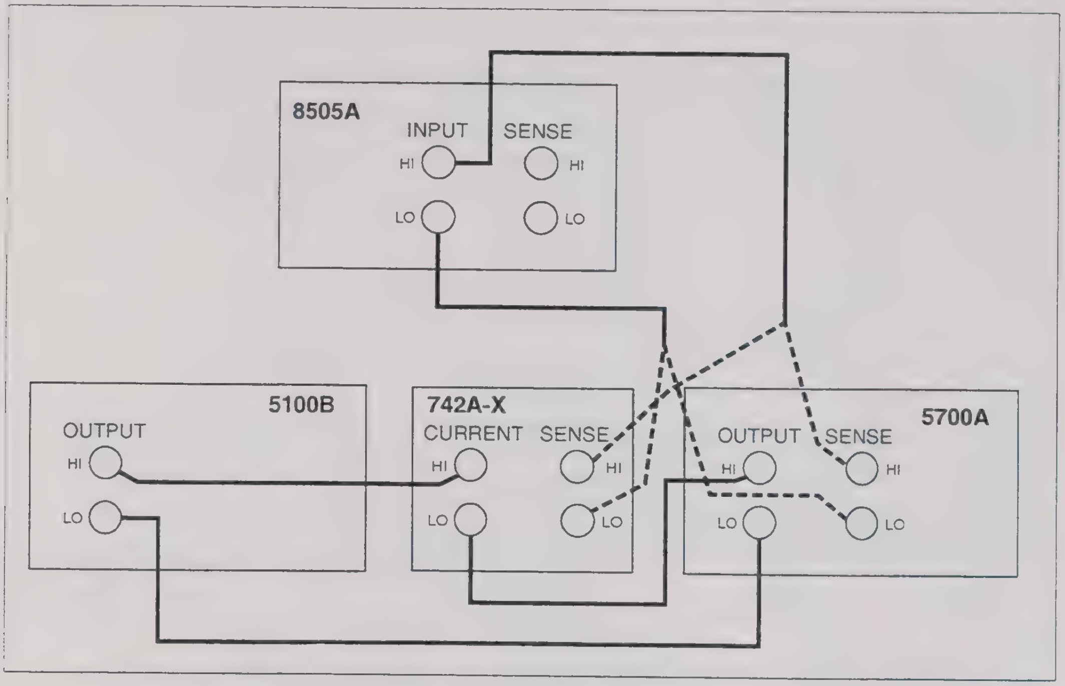


Figure 3-5. 1 Ohm and 10 Ohm Resistor Verification

Resistance Verification Test 3-10.

The following test requires testing at the high, low and intermediate values only. This is because the 5700A creates the other values of resistance from these values. For the convenience of anyone wishing to test the intermediate values, the tolerance limits are included. Testing these values could be done using a Hammon-type ratio device and a very stable, high-resolution bridge or DMM, or a combination of the two. Table 3-3 lists equipment required for this test. See Table 3-32, Minimum Use Requirements, for substitution information.

1. Connect the equipment as shown in Figure 3-5.
2. Set the 5700A output to 1Ω with external sensing (EX SENS indicator lit) and set the dc DMM to read dc V. Record the 1Ω resistance standard value on the test record as the 1Ω STD RES VALUE.
3. Multiply the certified value of the 1Ω resistance standard by 0.1 and record the result on the test record as the 1Ω STD VOLTAGE.
4. Connect the DMM across the sense terminals of the 1Ω resistance standard.
5. Set the direct current source for a nominal 100 mA output. Vary the source until the DMM reading is as close as possible to the 1Ω Standard Voltage recorded in the

Table 3-4. Low Value Resistance Calibration Using a Current Source

5700A RESISTANCE	APPLIED CURRENT	5700A DEVIATION FROM DISPLAYED VALUE*	5700A DISPLAYED VALUE
1Ω	100 mA	±95 ppm	0.9995 to 1.0005
1.9Ω	100 mA	±95 ppm	1.89905 to 1.90095
10Ω	10 mA	±28.0 ppm	9.997 to 10.003

* 90-day spec.

previous step. Record the DMM voltage reading on the test record as the MEASURED 1Ω STD VOLTAGE.

NOTE

If the current source used has the resolution to achieve a voltage reading to within ±5 ppm of the value in step 3, it is not necessary to calculate the cal current in the next step. In this case, when you come to step 9 you will simply multiply the voltage reading from step 9 by a factor of 10, which is the same as dividing by 100 mA (0.1A).

6. Calculate the exact current by dividing the MEASURED 1Ω STD VOLTAGE by the 1Ω STD RES VALUE; record the result on the test record as the CAL CURRENT.
7. Enter the 5700A displayed 1Ω value on the test record as the UUT 1Ω DISPLAYED VALUE.
8. Transfer the dc DMM leads to the 5700A sense terminals.
9. Enter the DMM voltage reading on the test record as the UUT 1Ω VOLTAGE.
10. Calculate the UUT true 1Ω resistance by dividing the UUT 1Ω VOLTAGE by the CAL CURRENT.
11. Adjust the output adjustment knob for a 5700A Control Display reading equal to the true 1Ω resistance value calculated in the previous step. The error from the displayed value is also shown on the Control Display. Enter the value of the error on the test record as the UUT DEVIATION FROM DISPLAYED VALUE.

NOTE

There is no need to do the cal current calculation of step 6 if the current source has a settability of ±3 ppm.

12. Repeat steps 3 through 11 for the 1.9Ω and 10Ω resistance values using the 1.9Ω and 10Ω resistance standards. At the 10 ohm check, use 10 mA of current and a multiplier for step 3 of 0.01.
13. The low-value (1Ω, 1.9Ω, and 10Ω) tests are summarized in Table 3-4.
14. For the remaining tests, no current source is required. Verify that each true 5700A value is within the limits shown in Table 3-5.
    a. Connect the DMM, set for 4-wire resistance, first to the Resistance Standard equal to the 5700A nominal output and then to the 5700A. In each case, record the resistance standard DMM reading and the resistance standard certified value.
    b. Calculate the DMM correction by subtracting the DMM reading from the certified value; enter this calculated value on the test record as DMM ERROR.
    c. Move the DMM to the 5700A (UUT) terminals; enter the DMM reading on the test record as DMM UUT RES RDG.
    d. Algebraically add the DMM ERROR and the DMM UUT RES RDG; enter the sum on the test record as UUT TRUE RES VALUE.
    e. Adjust the output adjustment knob for a 5700A Control Display reading equal to the true resistance value previously calculated. The error from the displayed value is also shown on the Control Display. Enter this error (with polarity reversed) on the test record as the UUT DEVIATION FROM DISPLAYED VALUE.

Table 3-5. Resistance Test Record

1Ω STD RES VALUE	1Ω STD VOLTAGE	MEASURED 1Ω STD VOLTAGE	CAL CURRENT	UUT 1Ω DISPLAYED VALUE	UUT 1Ω VOLTAGE	UUT TRUE RES	UUT DEVIATION FROM DISPLAYED VALUE	LIMIT OF DEVIATION FROM DISPLAYED VALUE	MAX DIFFERENCE OF CHARACTERIZED TO NOMINAL VALUE
								±95 ppm	.9995 to 1.0005
1.9Ω STD RES VALUE	**1.9Ω STD VOLTAGE**	**MEASURED 1.9Ω STD VOLTAGE**	**CAL CURRENT**	**UUT 1.9Ω DISPLAYED VALUE**	**UUT 1.9Ω VOLTAGE**	**UUT TRUE RES**	**UUT DEVIATION FROM DISPLAYED VALUE**	**LIMIT OF DEVIATION FROM DISPLAYED VALUE**	**MAX DIFFERENCE OF CHARACTERIZED TO NOMINAL VALUE**
								±95 ppm	1.89905 to 1.90095
10Ω STD RES VALUE	**10Ω STD VOLTAGE**	**MEASURED 10Ω STD VOLTAGE**	**CAL CURRENT**	**UUT 10Ω DISPLAYED VALUE**	**UUT 10Ω VOLTAGE**	**UUT TRUE RES**	**UUT DEVIATION FROM DISPLAYED VALUE**	**LIMIT OF DEVIATION FROM DISPLAYED VALUE**	**MAX DIFFERENCE OF CHARACTERIZED TO NOMINAL VALUE**
								±28 ppm	9.997 to 10.003

RESISTANCE ACCURACY VERIFICATION (19Ω AND ABOVE)

	STD RES VALUE	DMM STD RES RDG	DMM ERROR	DMM UUT RES RDG	UUT TRUE RES VALUE	UUT DEVIATION FROM DISPLAYED VALUE	LIMIT OF DEVIATION FROM DISPLAYED VALUE	MAX DIFFERENCE OF CHARACTERIZED TO NOMINAL VALUE
19Ω (1)							±26 ppm	18.9943 to 19.0057
100Ω (1)							±17 ppm	99.985 to 100.015
190Ω (1)							±17 ppm	189.9715 to 190.0285
1 kΩ (1)							±12 ppm	999.85 to 1000.15
1.9 kΩ (1)							±12 ppm	1.899715k to 1.900285k
10 kΩ							±11 ppm	9.9985k to 10.0015k
19 kΩ							±11 ppm	18.99715k to 19.00285k
100 kΩ (1)							±13 ppm	99.985k to 100.015k
190 kΩ (1)							±13 ppm	189.9715k to 190.0285k
1 MΩ (1)							±18 ppm	0.9998M to 1.0002M
1.9 MΩ (1)							±19 ppm	1.89962M to 1.90038M
10 MΩ (3)							±37 ppm	9.997M to 10.003M

Table 3-5. Resistance Test Record (cont)

	STD RES VALUE	DMM STD RES RDG	DMM ERROR	DMM UUT RES RDG	UUT TRUE RES VALUE	UUT DEVIATION FROM DISPLAYED VALUE	LIMIT OF DEVIATION FROM DISPLAYED VALUE	MAX DIFFERENCE OF CHARACTERIZED TO NOMIAL VALUE
19 MΩ (3)							±47 ppm	18.9943M to 19.0057M
100 MΩ (2)							±120 ppm	99.95M to 100.05M

NOTE 1: *Not necessary to test due to 5700A internal calibration process.*

NOTE 2: *Due to extremely slow settling time (approximately 5 minutes to 0.005% and sensitivity to any nearby movement, use of the DMM to test 100 megohms to the specified 0.01% uncertainty is not practical and therefore is not recommended. For those who wish to test it, a suitable way is to use an ESI SR 1050 10M/step Hammon-type Resistance Transfer Standard and use it in conjunction with an ESI 242-series bridge to effect the measurement to the required uncertainty.*

NOTE 3: *Standard used uncertainty at 10 MΩ of ±16 ppm will reduce the allowable limit from ±37 ppm to +/33 ppm. Standard used uncertainty at 10 MΩ of ±28 ppm will reduce the allowable limit to +/38 ppm. (Using the root-sum-square method of subtracting uncertainties.)*

Table 3-6. Equipment Required for DC Voltage Testing

EQUIPMENT	MODEL
DC Reference Standard	Fluke 732A
Reference Divider	Fluke 752A
Null Detector	Fluke 845A (B or R)

Two-Wire Compensation Verification 3-11.

Use the following steps to verify that two-wire compensation operates correctly:

1. Connect the 5700A (UUT) (output set to 100Ω, with external sensing) to the DMM (set for 4-wire resistance measurement). Note the DMM reading.
2. Connect two shorts: DMM SOURCE HI to SENSE HI and DMM SOURCE LO to SENSE LO.
3. Activate 5700A (UUT) 2-wire compensation.
4. Check that the DMM reading returns to within 4 milliohms of the reading noted in step 1.

DC Voltage Verification Test 3-12.

The following test checks every dc voltage range by testing the output accuracy at decade values of voltage from 100 mV to 1000V. Table 3-6 lists equipment required for this test as well as the Linearity Test that follows. See Table 3-32, Minimum Use Requirements, for equipment substitution information.

Proceed as follows to perform the dc voltage verification test:

1. Connect the equipment as shown in Figure 3-4.
2. Set the reference divider to 0.1V. Set the 5700A to the certified value of the dc reference standard divided by 100. For example, if the certified value of the dc reference standard is 10.000007V, set the 5700A to 100.00007 mV.

Table 3-7. Output Voltage Test Record

DIVIDER SETTING	5700A RANGE	5700A OUTPUT (NOTE 1)	NULL DETECTOR READING (µV) (NOTE 2)	NULL DET LIMIT (µV p-p)	METER LIMIT (µV) RATTLE
0.1V	0.22V	0.1V		±1.45 µV (# 2)	NA
1V	2.2V	1V		±7.2 µV (# 2)	0.55 µV
1V	11V	1V (# 3)		±9 µV (# 2)	2.2 µV
10V	11V	10V (# 4)		±54 µV	3.5 µV
10V	22V	10V (# 3)		±58 µV	5.5 µV
100V	220V	100V		±70 µV	7.5 µV
1000V	1100V	1000V		±86 µV	4.5 µV

NOTE 1: *Mathematically, the true 5700A output programmed is the certified value of the reference standard divided by the reference standard nominal value, multiplied by the required 5700A nominal output. In other words, the 5700A output is always programmed for the nominal output adjusted up or down by the same percentage as the certified value of the reference standard.*

NOTE 2: *On the 752A 0.1 and 1V ranges, the null detector polarity is reversed. A low input (5700A output) causes a positive null detector reading.*

NOTE 3: *Use Range Lock to obtain 1V on 11V and 10V on 22V range. Deactivate Range Lock before setting the next voltage output.*

NOTE 4: *Line regulation can be verified at this time by adjusting the autotransformer for a ±10% change in line voltage. The null detector reading must remain constant within ±1 µV.*

3. Press OPR/STBY. After the reading has settled, verify that the null detector reads 0V ±1.45 μV (the 90-day specification). Set the 5700A to standby.
4. Repeat the above process to test each 5700A dc voltage range output listed in Table 3-7. (0.1V is in the table for completeness; you do not need to repeat it.) After the null detector reading stabilizes, ensure that any observed meter rattle (over and above the null detector rattle in the "zero" position) over a ten-second period does not exceed the amount shown in the last column. In each case, set the 5700A to standby before changing to the next voltage settings and go back to operate before reading the null detector.
5. Reverse the connections of the dc reference standard at the reference divider and repeat the previous measurement process for the -0.1V and -10V 5700A outputs only.

DC Voltage One-Tenth Scale Linearity Test 3-13.

NOTE

If the result of the previous test at 1V on the 11V range was less than 2.5 μV it is not necessary to perform this test.

This test uses the same equipment as the previous test. Proceed as follows to perform the DC Voltage One-Tenth Scale Linearity Test:

1. Set the reference divider range to 10V. On the voltage reference standard, remove the lead from the 10V high terminal and connect it under the binding post of the low terminal along with the low lead to provide a 0V reference input to the reference divider. Set the 5700A output for 10V, then activate range lock for the 11V range. Now set the 5700A to 0V OPERATE.
2. Note the reading on the null detector. Press OFFSET on the 5700A. Return the lead on the voltage reference to the high output terminal.

Table 3-8. AC Voltage Frequency Accuracy Test Record

FREQUENCY	TOLERANCE	ACTUAL
10 Hz	99.99 ms - 100.01 ms	
15 Hz	66.673 ms - 66.66 ms	
100 Hz	9.999 ms - 10.001 ms	
200 Hz	199.98 Hz - 200.02 Hz	
500 Hz	499.95 Hz - 500.05 Hz	
1 kHz	999.9 Hz - 1000.1 Hz	
5 kHz	4999.5 Hz - 5000.5 Hz	
10 kHz	9.999 kHz - 10.001 kHz	
140 kHz	139.986 kHz - 140.014 kHz	
200 kHz	199.98 kHz - 200.02 kHz	
500 kHz	499.95 kHz - 500.05 kHz	
1 MHz	0.9999 MHz - 1.0001 MHz	

Table 3-9. Equipment Required for 5700A AC V Output Level Tests

EQUIPMENT	MODEL
AC/DC Transfer Standard	Fluke 792A
DMM	Fluke 8505A
Type "N" to Dual-Banana Plug Adapter	Pomona 1740

3. Set the 5700A to 10V. Use the 5700A output adjustment knob to obtain the reading previously noted on the null detector. Press SCALE on the 5700A.

4. Set the reference divider to the 1V range. Set the 5700A to 1V dc and verify that the null detector indicates less than 2.5 µV from the noted reading.

5. Press RESET on the 5700A. This completes the DC Voltage Calibration Verification testing.

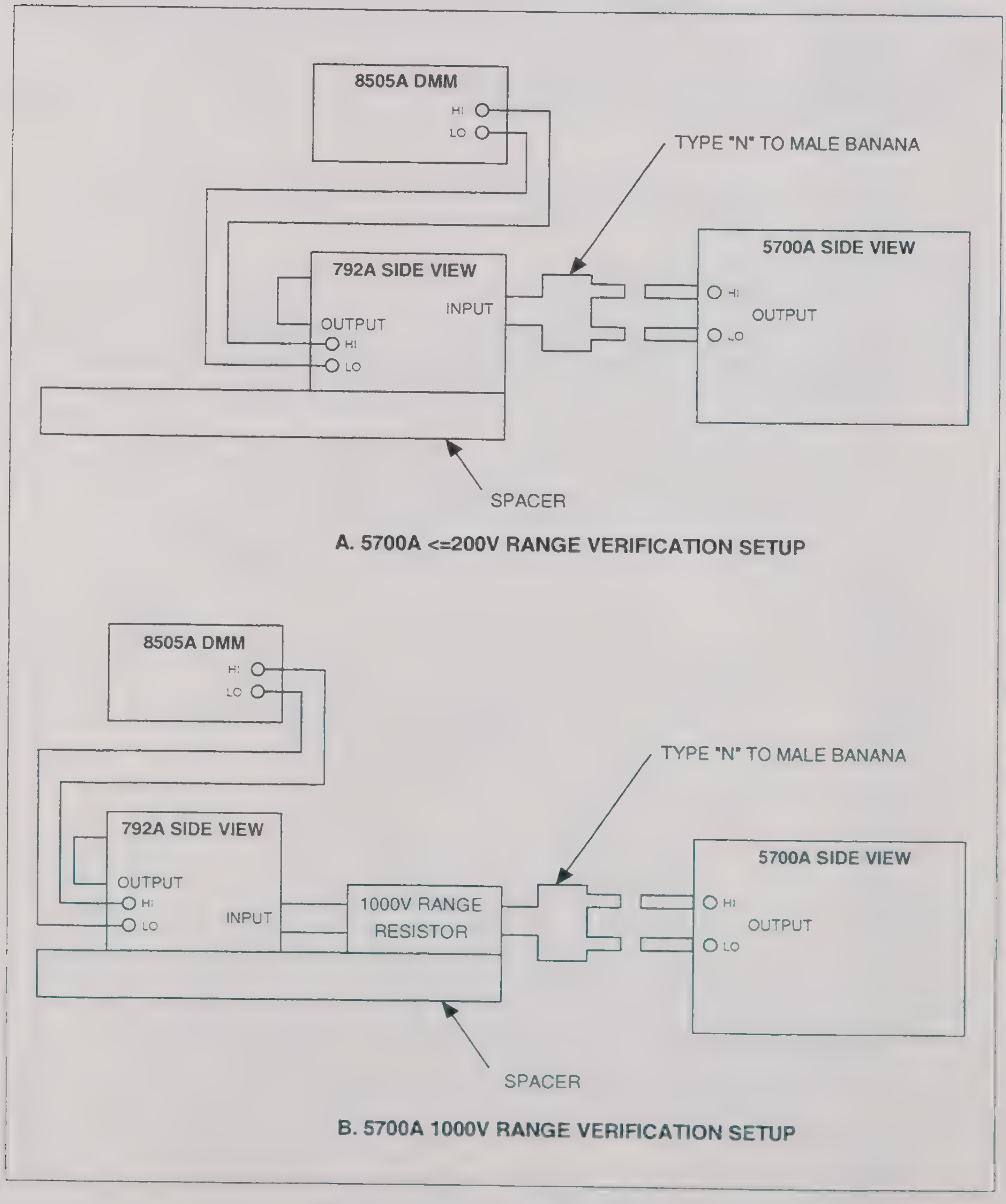


Figure 3-6. AC Voltage Test Setup

AC Voltage Frequency Accuracy Test 3-14.

This test requires the use of a frequency counter. Philips model PM6669 is recommended. Refer to Table 3-32, Minimum Use Requirements, for substitution information. To check the 5700A frequency accuracy, proceed as follows:

1. Connect the frequency counter to the output terminals of the 5700A.
2. Set the 5700A to 1V at the output frequencies listed in Table 3-8. Verify that the counter reads within the limits shown on the test record.
3. Disconnect the counter from the 5700A.

Output Level Tests for AC V Ranges 20 mV and Above 3-15.

This test requires the use of equipment listed in Table 3-9.

NOTE

Before beginning this test, refer to the Table of AC/DC Differences for the 792A Transfer Standard. Enter the transfer standard corrections for ac/dc difference for each level and frequency on to the test record.

1. Connect the equipment as shown in Figure 3-6a. Connect the transfer standard directly to the output of the 5700A using a Type "N" to male banana adapter.

CAUTION

Make sure the correct 792A range is selected before applying voltage to the 792A. Inputs to the 792A that exceed the protection level printed on its rear panel may disrupt the state of calibration and damage the transfer standard.

2. Turn on the 792A Power Pack and set the 792A to the 2.2V range.
3. Set the 5700A to 2V dc, internal sense, and operate.
4. Allow at least 30 seconds for the 792A to stabilize, then zero the DMM connected to the 792A using the DMM offset function.
5. Set the 5700A output to -2V. Adjust for any reversal error using the 5700A output adjustment knob and storing a new offset for equal offset for +2V and -2V. For example, if the offset when switching to -2V is +0.00004, store a new offset so that at +2V the DMM reads +0.00002 and at -2V the DMM reads -0.00002. Note: If you desire, you can produce the same result using the scaling function of the DMM instead of the 5700A offset function.
6. Set the 5700A to 2V at 1 kHz. Adjust the 5700A output using the output adjustment knob for a null (0.00000V) on the DMM. Record the 5700A error display reading on the test record. Algebraically add the 5700A error display reading to the previously entered transfer standard ac/dc difference, if any, and verify that the result is within 5700A specifications.
7. Set the 5700A output to +2V dc. Verify that the DMM offset reading returns to within ±5 ppm of the stored offset in step 5. If it does not, repeat steps 4 through 6 until the required result is achieved.

NOTE

For the remaining frequencies above 1 kHz this test uses a ac/ac transfer technique rather than ac/dc. This test references every frequency back to 1 kHz.

8. Set the 5700A to 2V at 1 kHz and zero the DMM using its offset function.
9. Refer to the test record (Table 3-10.) Set the 5700A to the next frequency point to be tested. Adjust the 5700A using the output adjustment knob for a null on the

Table 3-10. AC Voltage Output Test Record

OUTPUT LEVEL	FREQUENCY	TRANSFER STANDARD CORRECTION	ERROR DISPLAY READING	CALCULATED ERROR	90-DAY SPEC.	792A STD UNCERTAINTY < 4:1	REDUCED 90-DAY SPEC LIMITS (ROOT-SUM-SQUARE) (NOTE 4)
2V	1 kHz				78.5 ppm	OK	N/A
2V	20 kHz				78.5 ppm	OK	N/A
2V	50 kHz				140 ppm	40	134
2V	100 kHz				290 ppm	OK	N/A
2V	300 kHz				515 ppm	OK	N/A
2V	500 kHz				0.13 %	OK	N/A
2V	1 MHz				0.27 %	OK	N/A
2V	40 Hz				78.5 ppm	25 ppm	74 ppm
2V	20 Hz				185 ppm	60 ppm	175 ppm
2V	10 Hz				600 ppm	190 ppm	569 ppm
2.3V (NOTE 1)	1 kHz				105.4 ppm	OK	N/A
20V	1 kHz				78.5 ppm	OK	N/A
20V	20 kHz				78.5 ppm	OK	N/A
20V	50 kHz				140 ppm	40	134
20V	100 kHz				270 ppm	OK	N/A
20V	300 kHz				635 ppm	OK	N/A
20V	500 kHz				0.155 %	OK	N/A
20V	1 MHz				0.325 %	OK	N/A
20V (NOTE 2)	40 Hz				78.5 ppm	25	74
20V	20 Hz				185 ppm	60	175
20V	10 Hz				600 ppm	190	570
200 mV	1 kHz				150 ppm	OK	N/A
200 mV	20 kHz				150 ppm	OK	N/A
200 mV	50 kHz				380 ppm	OK	N/A
200 mV	100 kHz				950 ppm	OK	N/A
200 mV	300 kHz				0.12 %	OK	N/A
200 mV	500 kHz				0.19 %	OK	N/A
200 mV	1 MHz				0.38 %	OK	N/A
200 mV	40 Hz				150 ppm	40	145
200 mV	20 Hz				270 ppm	80	258
200 mV	10 Hz				630 ppm	200	597
20 mV	1 kHz				410 ppm	125	390
20 mV	20 kHz				410 ppm	125	390
20 mV	50 kHz				670 ppm	200	640

Table 3-10. AC Voltage Output Test Record (cont)

OUTPUT LEVEL	FREQUENCY	TRANSFER STANDARD CORRECTION	ERROR DISPLAY READING	CALCULATED ERROR	90-DAY SPEC.	792A STD UNCERTAINTY < 4:1	REDUCED 90-DAY SPEC LIMITS (ROOT-SUM-SQUARE) (NOTE 4)
20 mV	100 kHz				0.13 %	450	1220
20 mV	300 kHz				0.20 %	650	1840
20 mV	500 kHz				0.32 %	1000	3040
20 mV	1 MHz				0.48 %	OK	N/A
20 mV	40 Hz				410 ppm	140	385
20 mV	20 Hz				520 ppm	180	488
20 mV	10 Hz				850 ppm	280	803
200V	1 kHz				85 ppm	OK	N/A
200V	20 kHz				85 ppm	OK	N/A
200V	50 kHz				240 ppm	OK	N/A
200V	100 kHz				600 ppm	OK	N/A
200V (NOTE 2)	40 Hz				85 ppm	27 ppm	81 ppm
200V	20 Hz				185 ppm	60 ppm	175 ppm
200V	10 Hz				600 ppm	190 ppm	569 ppm
300V (NOTE 3)	20 kHz				145 ppm	OK	N/A
600V (NOTE 3)	50 kHz				378 ppm	OK	N/A
600V (NOTE 3)	100 kHz				0.1375 %	OK	N/A
1000V	1 kHz				84 ppm	25 ppm	80 ppm
1000V	50 Hz				84 ppm	27 ppm	80 ppm
1000V	300 Hz				84 ppm	25 ppm	80 ppm
1000V (NOTE 3)	20 kHz				131 ppm	OK	N/A
1000V (NOTE 3)	30 kHz				371 ppm	OK	N/A
1000V (NOTE 3)	40 Hz				84 ppm	27 ppm	80 ppm

NOTE 1: *This is a test of the bottom of the 20V range and will require re-referencing at 2.3V dc.*

NOTE 2: *Observe the 5700A output for 10 minutes and verify that it remains within ±7.5 ppm. Return to 1 kHz and algebraically subtract from the reading any drift from the 792A.*

NOTE 3: *Perform only for units that are used with a 5725A Amplifier.*

NOTE 4: *The RSS (root-sum-square) method was used to obtain reduced uncertainty for standard unxcertainties of less than 4:1. For example at 2V, 40 Hz, the 5700A 90-day specification is 78.5 ppm and 792A is 26 ppm. The reduced specification limit can be calculated by the equation:*

$$\sqrt{(78.5\,ppm)^2 - (26\,ppm)^2} = 74\,ppm.$$

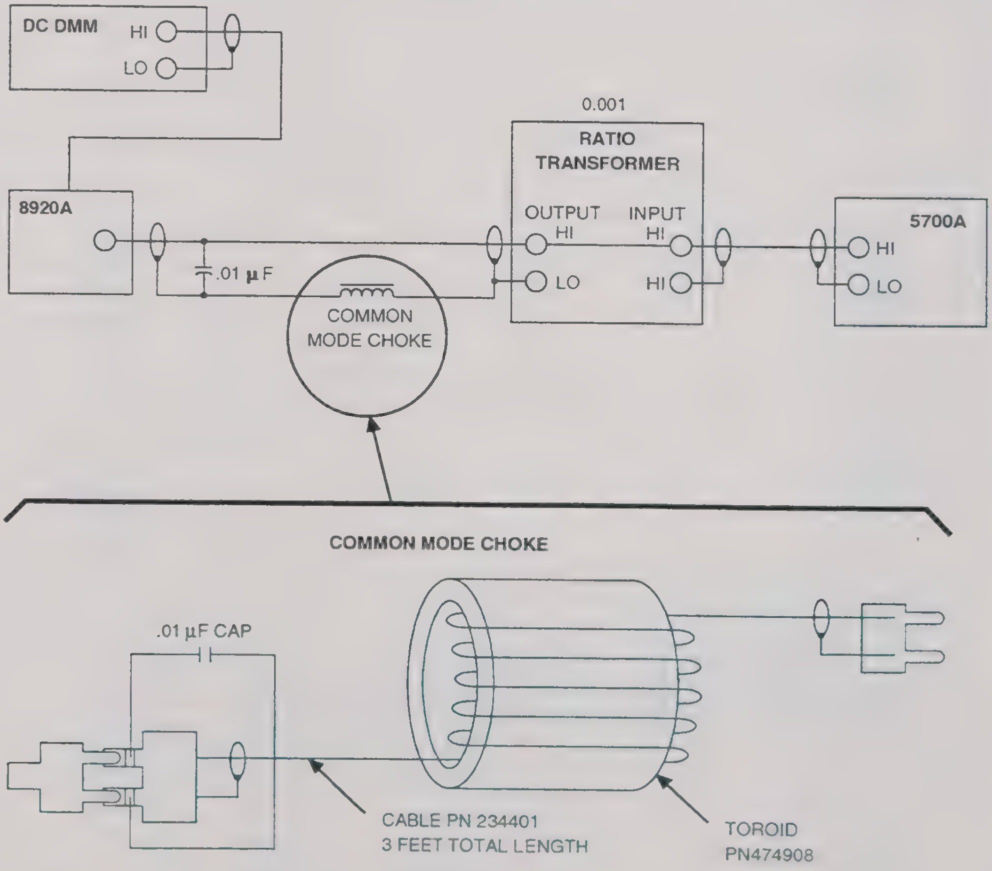
DMM and record the 5700A error display reading on the test record. Algebraically add the error display reading to the recorded transfer standard ac/dc difference and to any noted error display reading at 1 kHz measured in step 6. Verify the result is within specifications of the 5700A.

10. Repeat the previous step for all remaining frequencies on the test record.

11. Repeat this procedure at the 20 V, 200 mV, 20 mV and 200V ranges. At all voltages be sure the 792A RANGE SELECT switch is set to the appropriate range before applying voltage. At voltages above 200V for the 792A, use the 1000V range resistor and set the 792A to 2.2V. Refer to Figure 3-6b for connections.

NOTE

If a direct measuring transfer standard is not available for the 20 mV and 200 mV ranges, use the Alternate Procedure For 20 mV and 200 mV Verification following the Optional Tests near the end of Section 3.



NOTE: LOOP CABLE THROUGH TOROID 5 TIMES.

Figure 3-7. Absolute Level Verification, 2 mV at 1 kHz Test Setup

AC Voltage 2 mV Range Output Level Test 3-16.

The 2 mV ac range is generated by the same 1000:1 divider, and it uses the same signal path as used to generate the 20 mV range. The difference being the Oscillator assembly is switched from the 20V range to the 2V range. Since the 2V range and 20 mV range have been previously verified for absolute uncertainty and flatness, you can verify the 2 mV range by making an absolute check at 1 kHz. It is not necessary to check the flatness of the 2 mV range, but if a flatness check is desired, refer to Optional Tests.

This test uses the previously measured 5700A 2V range and a ratio transformer to establish an absolute 1.9 mV level at 1 kHz on a rms wideband voltmeter/dc DMM combination. These meters function as a transfer device in measuring the accuracy of the 2 mV range.

To eliminate hf noise errors in this measurement, use a common-mode choke and a filter capacitor. The capacitor should be a 0.01 µF. Figure 3-7 shows how to build the common-mode choke.

Absolute Level Verification of 2 mV Range at 1 kHz. 3-17.

Proceed as follows to verify the absolute level of the 2 mV ac voltage range at 1 kHz:

1. Connect the equipment as shown in Figure 3-7.
2. Set the 5700A output to 1.9V at 1 kHz. Using the output adjustment knob, adjust the output for an error display reading that is the same as the calculated error for 2V, 1 kHz in Table 3-10, Output Level Tests for AC Voltage Ranges 20 mV and Above.
3. Set the ratio transformer to 0.001 and record the reading of the dc DMM as the CHARACTERIZED 1.9 mV READING on the test record (Table 3-11.).
4. Disconnect the ratio transformer from the setup. Set the 5700A to 1.9 mV at 1 kHz and connect the rms voltmeter/dc DMM combination to the output of the 5700A. The common mode choke and filter capacitor must remain in place. Adjust the 5700A output using the output adjustment knob until the dc DMM reads the same as recorded in the previous step. Record the 5700A error display reading on the test record and verify that it is within the limits shown.

Direct Current Accuracy Verification Test 3-18.

Equipment required for the Direct Current Accuracy Verification Test is listed in Table 3-12. Proceed as follows to test accuracy of the dc current function:

Table 3-11. AC Voltage 2 mV Range Test Record

CHARACTERIZED 1.9 mV READING	ERROR DISPLAY READING	LIMITS
		± 0.26%

Table 3-12. Equipment Required for Direct Current Test

EQUIPMENT	MODEL
DC DMM, 6-1/2 digit	Fluke 8505A
High-Current Shunt	Fluke Y5020 (for 5725A only)
Resistance Standards	L&N 0.1Ω rated at 2A Fluke 742A-1 (1Ω at 200 mA) Fluke 742A-10 (10Ω at 20 mA) Fluke 742A-1k (1 kΩ at 2 mA) Fluke 742A-10k (10 kΩ at 200 µA)

Table 3-13. Direct Current Accuracy Test Record

CHARACTERIZING DC DMM @ ±200 MV AND ± 2.0V					
OUTPUT CURRENT	STD RES VALUE	COLUMN A STD RES CORRECTION	COLUMN B UUT ERROR READING	UUT ACTUAL ERROR (A+B)	LIMIT OF ERROR
+2A	0.1Ω				±95 ppm
-2A	0.1Ω				±95 ppm
+200 mA	1.0Ω				±65 ppm
-200 mA	1.0Ω				±65 ppm
+20 mA	10Ω				±55 ppm
+2 mA	1 kΩ				±55 ppm
-2 mA	1 kΩ				±55 ppm
+200 μA	10 kΩ				±100 ppm

5725A AMPLIFIER DC CURRENT TEST				
OUTPUT CURRENT	DC DMM RDG	SHUNT CERT VALUE	CAL ACTUAL CURRENT	LIMITS
+10A				±388 ppm
-10A				±388 ppm
+5A				±436 ppm
+3A				±500 ppm
-3A				±500 ppm

1. Connect the dc DMM to the 5700A output and set the 5700A for outputs of 200 mV, -200 mV, 2V, and -2V, and record the dc DMM reading at each voltage in Table 3-13.
2. Refer to the resistance standard test report and enter the corrections for all the certified values in ± ppm in column A on the test record.
3. Connect the equipment as shown in Figure 3-8 using the L&N 0.1Ω resistor.
4. Set the 5700A for a 2A dc output, and adjust the 5700A using the output adjustment knob to obtain the characterized voltage reading on the dc DMM. Wait 3 seconds, and record the 5700A error display reading in ± ppm (Column B).
5. Algebraically add column B to column A. Enter the result on the test record. Verify that it is within the limits shown.
6. Repeat steps 2 through 5 using the Fluke 742A Resistance Standards and 5700A output currents shown in Table 3-13.
7. If the 5700A is attached to a 5725A Amplifier, connect the Y5020 shunt to the 5725A output terminals. Connect the dc DMM to the Y5020 SENSE connector.
8. Set the 5700A to 10A, -10A, 5A, 3A and -3A and record the dc DMM readings on the test record. Divide these readings by the certified value of the Y5020, record the resultant current and verify that it is within the tolerances shown.
9. This completes the direct current accuracy verification.

AC Current Test, 22 mA to 11A Ranges 3-19.

Equipment required for the Alternating Current Accuracy Verification Test is listed in Table 3-14. Proceed as follows to test the accuracy of the ac current function:

1. Enter the ac to dc difference corrections for each shunt at each frequency in the appropriate column of the test record (Table 3-15).

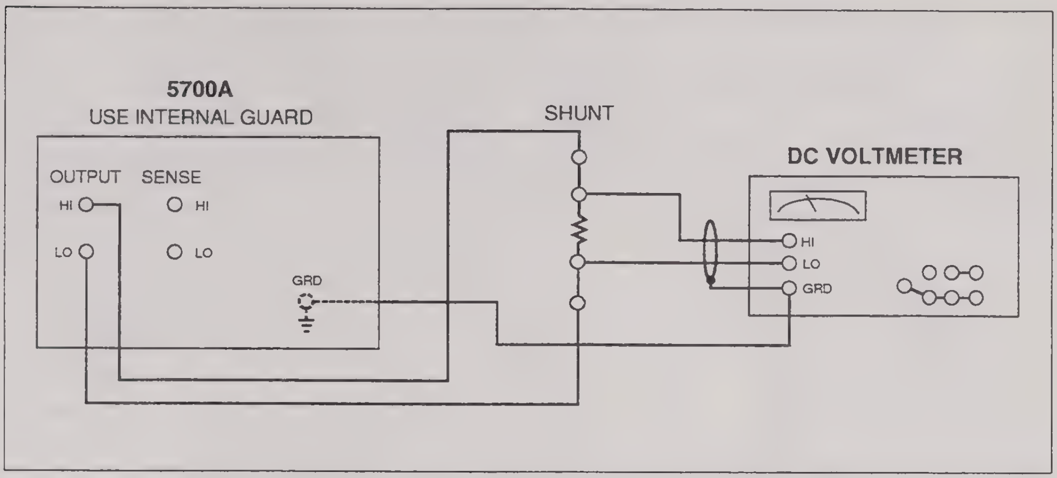


Figure 3-8. Direct Current Accuracy Test Setup

Table 3-14. Equipment Required for Alternating Current Test

EQUIPMENT	MODEL OR DESCRIPTION
Thermal Transfer Standard	Fluke 540B
AC/DC Transfer Standard	Fluke 792A
Current Shunts	Fluke A40 Series: 20 mA, 200 mA, 2A, and 10A with AC-DC difference corrections
DMM	Fluke 8505A
T9 Metal-Film Resistors	200Ω and 2 kΩ values, securely mounted in a dual banana plug

2. Connect the equipment as shown in Figure 3-9. Use the 2A Current shunt.
3. Set the 5700A for a +2A dc output. Adjust the output so that the error display is equal to the UUT actual error for a +2A output, as shown on the dc current test record.
4. Allow sufficient time (usually around 10 minutes for the first reading) for the transfer standard null meter reading to stabilize. Adjust the transfer standard null controls for a precise null indication.
5. Proceed as follows to obtain an average of the reversed dc to obtain a reference for the ac:
   a. Adjust the transfer standard null controls for a null with a positive polarity current from the 5700A.
   b. Reverse the current polarity into the transfer standard by pushing the POLARITY (push to reverse) button on the transfer standard.
   c. Record the final deflection on the transfer standard null meter in + or - small divisions.
   d. Push the POLARITY button on the transfer standard again for positive polarity. Verify that the null meter returns to a precise null.
   e. Adjust the transfer standard controls to obtain one-half the deflection recorded in step c, but in the opposite direction. For example, if you recorded +4.7 divisions for step c, the correct offset for step e would be -2.4 divisions (rounded to the nearest tenth).

Table 3-15. AC Current 20 mA to 10A Accuracy Test Record

2A, 200 mA, 20 mA AND 10A TEST RECORD (10A ONLY FOR 5725A)					
OUTPUT CURRENT	FREQ	A40 SHUNT AC-DC DIFF	UUT ERROR DISPLAY	CALCULATED ERROR	ERROR LIMITS
2A	40 Hz				±670 ppm
2A	1 kHz				±670 ppm
2A	5 kHz				±800 ppm
2A	10 kHz				±0.91%
200 mA	10 Hz				±725 ppm
200 mA	20 Hz				±400 ppm
200 mA	40 Hz				±170 ppm
200 mA	1 kHz				±170 ppm
200 mA	5 kHz				±850 ppm
200 mA	10 kHz				±0.21%
20 mA	10 Hz				±725 ppm
20 mA	20 Hz				±400 ppm
20 mA	40 Hz				±160 ppm
20 mA	1 kHz				±160 ppm
20 mA	5 kHz				±850 ppm
20 mA	10 kHz				±0.21%
10A	40 Hz				±417 ppm
10A	1 kHz				±417 ppm
10A	5 kHz				±885 ppm
10A	10 kHz				±0.34%

6. Set the 5700A to 2A at 40 Hz OPERATE.
7. Without touching the transfer standard null controls, use the 5700A output adjustment knob to adjust the 5700A output as necessary to obtain a null on the transfer standard null meter. Enter and verify the result on the test record.
8. Algebraically add the 5700A error display reading to the A40 Shunt ac to dc difference, and verify that the result is within the specifications of the 5700A.
9. Set the 5700A to 2A dc. Verify that the transfer standard null meter returns to the setting in step 5e. If necessary, repeat steps 3 through 7 until the required result is obtained.
10. Change the 5700A frequency to 1 kHz, 5 kHz, and 10 kHz. At each frequency, edit the 5700A for a null on the transfer standard null meter. Enter and verify the results as done in steps 7 and 8.
11. Repeat steps 3 through 10 at currents of 200 mA and 20 mA using the appropriate A40 current shunt at the frequencies shown on the test record (Table 3-15).
12. For units with a 5725A Amplifier attached, repeat steps 3 through 10 at 11A using the 10A current shunt at the frequencies listed on the test record.

AC Current Test, 2 mA and 200 μA Ranges 3-20.

If you have a Fluke 792A AC/DC Transfer Standard available, proceed as follows to test the accuracy of the 2 mA ac and 200 μA ac ranges. (If a 792A is not available, use the alternate procedure following Optional Tests at the end of this section.

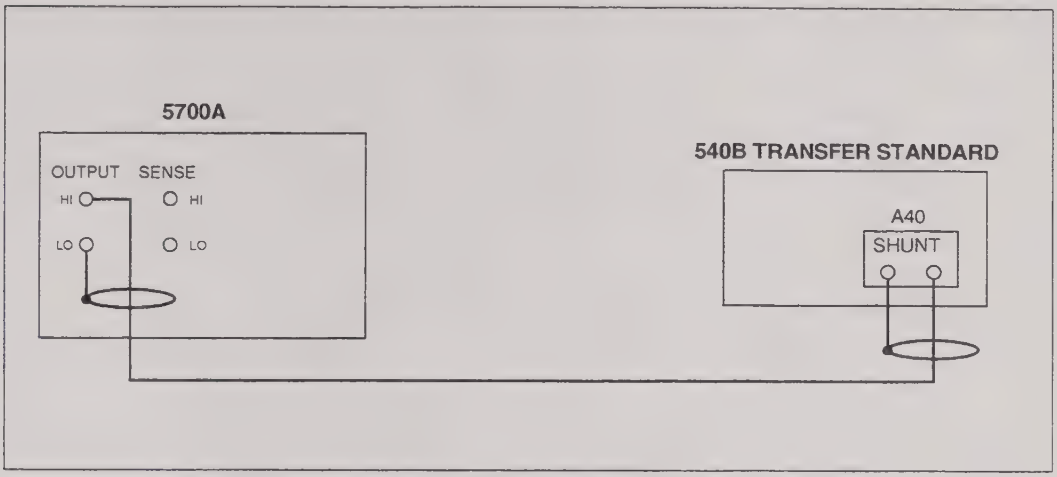


Figure 3-9. Alternating Current Test Setup, 22 mA to 10A

1. Connect the equipment as shown in Figure 3-10. Set the 792A INPUT RANGE knob to 700 mV.

NOTE

An explanation of the rationale for using metal film resistors to measure ac current follows this procedure.

2. Set the 5700A for precisely 2 mA dc using the correction from previously recorded data, i.e. set the error display to the value recorded for +2 mA dc (Table 3-16).
3. Allow 1 minute for the 792A to stabilize, then zero the DMM connected to the 792A using the DMM offset function.
4. Reverse the output polarity of the 5700A. Adjust for any reversal error using the 5700A output adjustment knob and storing a new offset for equal offset for positive and negative outputs. For example, if the offset when switching to negative output is +0.00004, store a new offset so that with a positive output, the DMM reads -0.00002 and with a negative input, the DMM reads +0.00002. (If you desire, you can produce the same result using the scaling function of the DMM instead of the 5700A offset function. Set the 5700A to standby.)
5. Set the 5700A for 2 mA ac outputs at 10 Hz, 20 Hz, 40 Hz, 1 kHz, 5 kHz, and 10 kHz. At each frequency, adjust the 5700A output adjustment knob until the dc DMM connected to the 792A reads a null. Record the error display each time in Table 3-16 and verify that it is within the limits shown.
6. Repeat steps 1 through 5, but replace the 200Ω metal film resistor with a 2 kΩ metal film resistor, and use 200 μA instead of 2 mA.

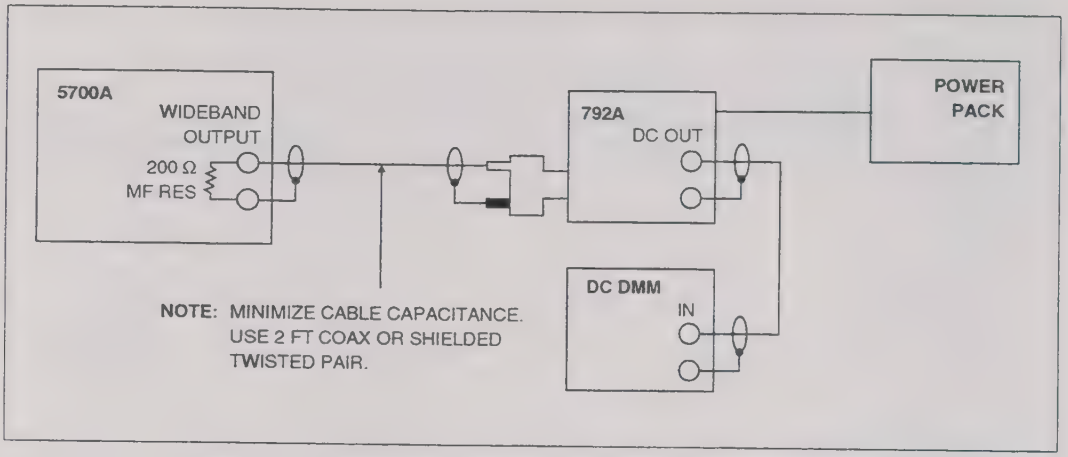

5700A
WIDEBAND OUTPUT
200 Ω MF RES
792A
DC OUT
POWER PACK
DC DMM
IN
NOTE: MINIMIZE CABLE CAPACITANCE. USE 2 FT COAX OR SHIELDED TWISTED PAIR.

Figure 3-10. Alternating Current Test Setup, 2 mA and 200µA

Table 3-16. AC Current 2 mA and 200 µA Accuracy Test Record

FREQUENCY	2 mA AC OUTPUT UUT ERROR DISPLAY	ERROR LIMITS
10 Hz		±725 ppm
20 Hz		±400 ppm
40 Hz		±160 ppm
1 kHz		±160 ppm
5 kHz		±850 ppm
10 kHz		±0.21%
FREQUENCY	**200 µA AC OUTPUT UUT ERROR DISPLAY**	**ERROR LIMITS**
10 Hz		±850 ppm
20 Hz		±505 ppm
40 Hz		±240 ppm
1 kHz		±240 ppm
5 kHz		±850 ppm
10 kHz		±0.21%

Rationale for Using Metal-Film Resistors to Measure AC 3-21.

To be able to measure alternating current, a system comprised of a suitable ac shunt and and ac detector is required. First let us consider the ac shunt. For this example we will use a 2 kΩ metal film resistor. At frequencies up to 10 kHz, the equivalent circuit of the resistor can be illustrated as in Figure 3-11. Values typical for shunt capacitance and shunt inductance are 2 pF (Cs) and 0.01 µH (Ls). For comparison, wire has approximately 0.02 µH/inch. At 10 kHz, the reactance of Cshunt is 8 MΩ, and the reactance of Lshunt is 0.6 mΩ. The formulae to use are:

$$(1/Z)^2 = (1/R)^2 + (1/XC)^2 \quad (1)$$

$$(1/Z)^2 = (1/R)^2 + (1/XL)^2 \quad (2)$$

Where R = resistance, and
Z = network impedance

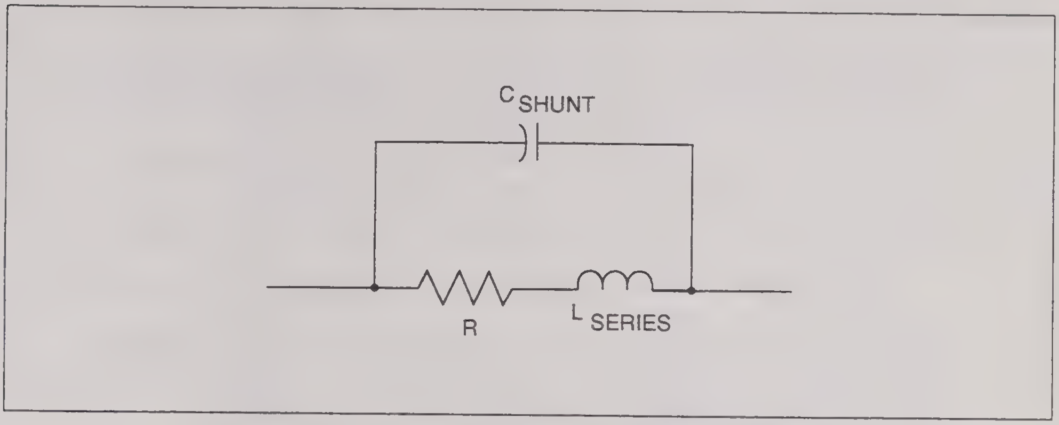


Figure 3-11. Metal Film Resistor Equivalent Circuit

We can see that these effects can be ignored, because their contribution to errors in the measurement process is less than 1 ppm. That is, the metal film resistor's self reactance is totally dwarfed by the reactance of the measuring circuit, which is overwhelmingly capacitive.

If a detector as shown in Figure 3-12 has an input impedance of 1 MΩ shunted by 180 pF, then the effects of Xc must be accounted for. For purposes of illustration we can ignore the net resistance change introduced by the 1 MΩ detector resistance. If necessary, this could be established by a dc measurement.

NOTE

The input impedance of the 792A millivolt ranges is 30 pF shunted by 10 MΩ. RG/58A coaxial cable has capacitance of about 30 pF/ft.

Using formula (2) we get a result of Xc = 88 kΩ, and a network impedance of Z = 1.9995 kΩ. This produces an error of approximately 250 ppm, or 0.025%. However, if we are making a measurement of 0.21% uncertainty (as in the present case), the ratio of measurement uncertainty is about 10:1 and is not of concern. It is easy to improve measurement uncertainty if desired, though, by measuring the actual input capacitance of the detector and any stray capacitance from input leads, etc. and making corrections. In this discussion, the UUT is assumed to be a high-impedance current source (like the 5700A), which can easily be verified by the manufacturer's specifications, i.e., a specified voltage adder for current outputs above a given burden voltage.

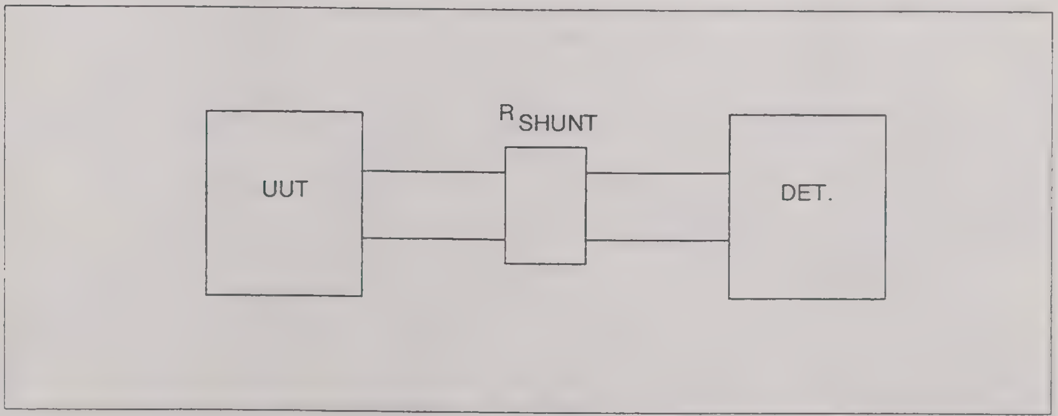


Figure 3-12. Metal Film Resistor in Test Circuit

Wideband AC Voltage Module Output Verification 3-22.

The wideband tests are for units with the Option 5700A-03 Wideband AC Module only. The verification test for the wideband module works as follows:

- Accuracy at 1 kHz: Output at 1 kHz is tested using a characterized rf voltmeter reading the output across a precision dc 50Ω termination.
- Flatness relative to 1 kHz: First the 3V range is tested using the following process:
    1. Characterizing a 50Ω detector using a 3V Thermal Voltage Converter (TVC).
    2. Using the characterized 50Ω detector to read the 5700A 3V output flatness and recording the 5700A error display to get corrections for the next test. The absolute accuracy at frequencies between 30 Hz and 500 kHz will also be verified by inspection of the data.
- Attenuator Flatness: The attenuator flatness is tested using the following process:
    1. The 3V range corrections are used via 5700A error display to serve as a reference for characterizing the Attenuator Test Setup at a reduced number of frequencies.
    2. Each attenuator section is tested using a "put and take" method involving removal of 10 dB of external standard attenuation to correspond to each added 10 dB section of the 5700A.

Table 3-17 lists the equipment required for testing and calibrating the Wideband module.

WIDEBAND FREQUENCY ACCURACY TEST 3-23.

Proceed as follows to test the Wideband module frequency accuracy:

1. Connect the frequency counter to the 5700A wideband output and measure the 5700A output frequency at the frequencies listed in Table 3-18.
2. Verify that the frequency counter indicates frequencies within the 0.01% limits shown.

Table 3-17. Equipment Required for the Wideband Option

EQUIPMENT	MODEL
Wideband RMS Voltmeter	Fluke 8920A
DMM	Fluke 8505A
3V Thermal Voltage Converter	Fluke A55
20 dB RF Attenuator (Qty. 3)	Narda 777C-20
10 dB RF Attenuator (Qty. 1)	Narda 777C-10
20 dB Amplifier (Qty. 2)	Comlinear CLC100
Ratio Transformer	ESI DT72A
±12V Power Supply	(Any)
0.01 µF Capacitor	(Any)
Wideband Cable	Supplied with Option 5700A-03
50Ω Termination	Supplied with Option 5700A-03

Table 3-18. Frequency Testing Points

FREQUENCY (Hz)	TOLERANCE LIMITS
10 Hz	99.99 ms to 100.01 ms
100 Hz	9.999 ms to 10.001 ms
300 Hz	299.97 Hz to 300.03 Hz
500 Hz	499.95 Hz to 500.05 Hz
800 Hz	799.92 Hz to 800.08 Hz
900 Hz	899.91 Hz to 900.09 Hz
1 kHz	999.0 Hz to 1.0001 kHz
1.19 kHz	1.189881 kHz to 1.190119 kHz
2.2 MHz	2.19978 MHz to 2.20022 MHz
3.5 MHz	3.49965 MHz to 3.50035 MHz
3.8 MHz	3.79962 MHz to 3.80038 MHz
10 MHz	9.990 MHz to 10.001 MHz
20 MHz	19.998 MHz to 20.002 MHz
30 MHz	29.997 MHz to 30.003 MHz

WIDEBAND OUTPUT ACCURACY AT 1 kHz TEST 3-24.

This test verifies the Wideband output level at 1 kHz by comparing it to the 5700A main output. This is done by using the 5700A main output to characterize a rms wideband voltmeter/dc DMM combination. Due to the accuracy specification of the 5700A Wideband module at 3 mV and 1 mV it is necessary to ratio down the main output at 3V and 1V to establish a reference at these lower levels.

Proceed as follows to characterize the rms wideband voltmeter at 1 kHz:

1. Connect the equipment as shown in Figure 3-7. To eliminate hf noise errors in this measurement, use a common-mode choke and a filter capacitor. The capacitor should be a 0.01 μF. Figure 3-7 shows how to build the common-mode choke.

2. Set the ratio transformer to 0.001.

3. Set the 5700A main output to 3V and 1V. At each level record the reading of the dc DMM connected to the rms wideband voltmeter in the test record as the 3 mV and 1 mV level.

4. Remove the ratio transformer from the setup and connect the special common mode rejection cable directly to the 5700A main output terminals.

5. Set the 5700A main output to the voltage levels from 3V to 10 mV as listed on the test record. At each level record the dc DMM reading on the test record (Table 3-19).

6. Connect the equipment as shown in Figure 3-13.

7. Set the 5700A wideband output for all the levels listed in Table 3-19 and use the output adjustment knob to obtain the dc DMM reading previously recorded. Record the 5700A error display reading and verify that it is within the limits shown.

Table 3-19. Wideband Accuracy at 1 kHz Test Record

OUTPUT LEVEL	DC DMM READING OF 5700A MAIN OUTPUT	WIDEBAND OUTPUT ERROR DISPLAY READING	LIMITS
3.0V			±0.22%
1.0V			±0.29%
0.3V			±0.28%
0.1V			±0.34%
30 mV			±0.33%
10 mV			±0.39%
3 mV			±0.48%
1 mV			±0.54%

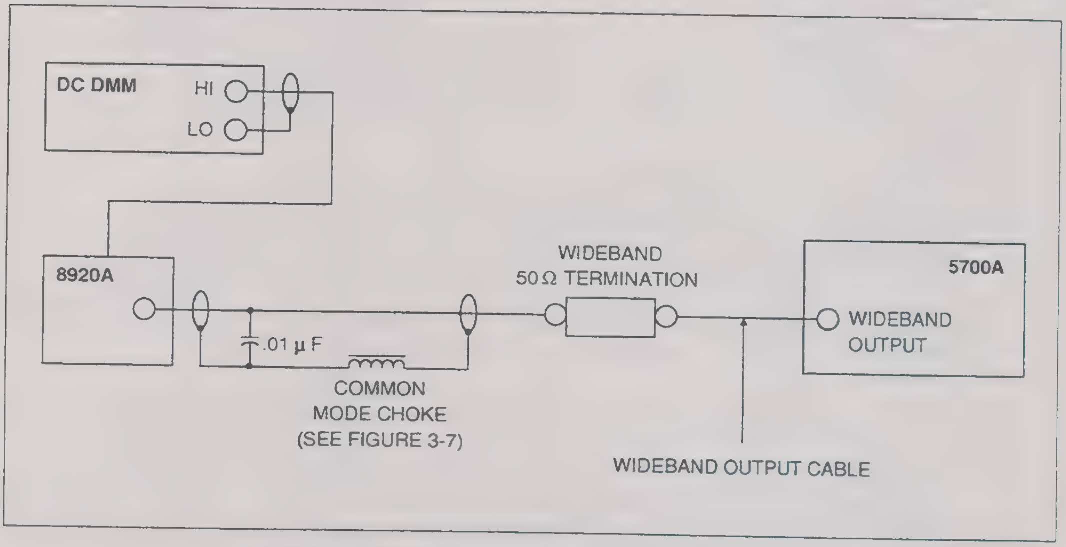


Figure 3-13. Wideband Accuracy at 1 kHz Test Setup

WIDEBAND OUTPUT FLATNESS TEST 3-25.

NOTE

The following test uses a non-50Ω thermal voltage converter (TVC) to characterize a 50Ω system. For 5700A wideband flatness calibration to be valid, the 5700A must be connected to a good 50Ω device or system. It is not satisfactory to just parallel the input of the TVC with a good rf 50Ω (especially at frequencies above 10 MHz). However, the TVC will indicate the actual voltage at the center of a Type-874 tee connector in parallel with 50Ω. Therefore, it is valid to calibrate the 50Ω system with the TVC at the other end of a Type-874 tee. **Note that while the TVC is connected, the 5700A wideband output is functioning only as an uncalibrated voltage source.**

NOTE

Before beginning this test, obtain a copy of your 3V TVC test report. Any corrections that exceed the following will have to be applied. Note any corrections that exceed these levels for future reference.

- 0.01% to 2 MHz
- 0.02% to 10 MHz
- 0.04% to 20 MHz
- 0.1% to 30 MHz

50Ω System Characterization 3-26.

First you must perform 50Ω system characterization. To do so, proceed as follows:

1. Connect the equipment as shown in Figure 3-14.
2. Set the 5700A for a wideband output of 2.7V at 1 kHz.
3. Adjust the 5700A using the output adjustment knob to obtain a convenient reference reading (such as 0.90000V) on the dc DMM connected to the rms wideband voltmeter analog output. (Note: do not use log output if the meter is so equipped).
4. Allow sufficient time for the TVC to stabilize. Five to ten minutes is sufficient unless the TVC body has not reached ambient temperature before voltage is applied. Zero the 8505A DMM connected to the TVC output using the DMM's offset function.

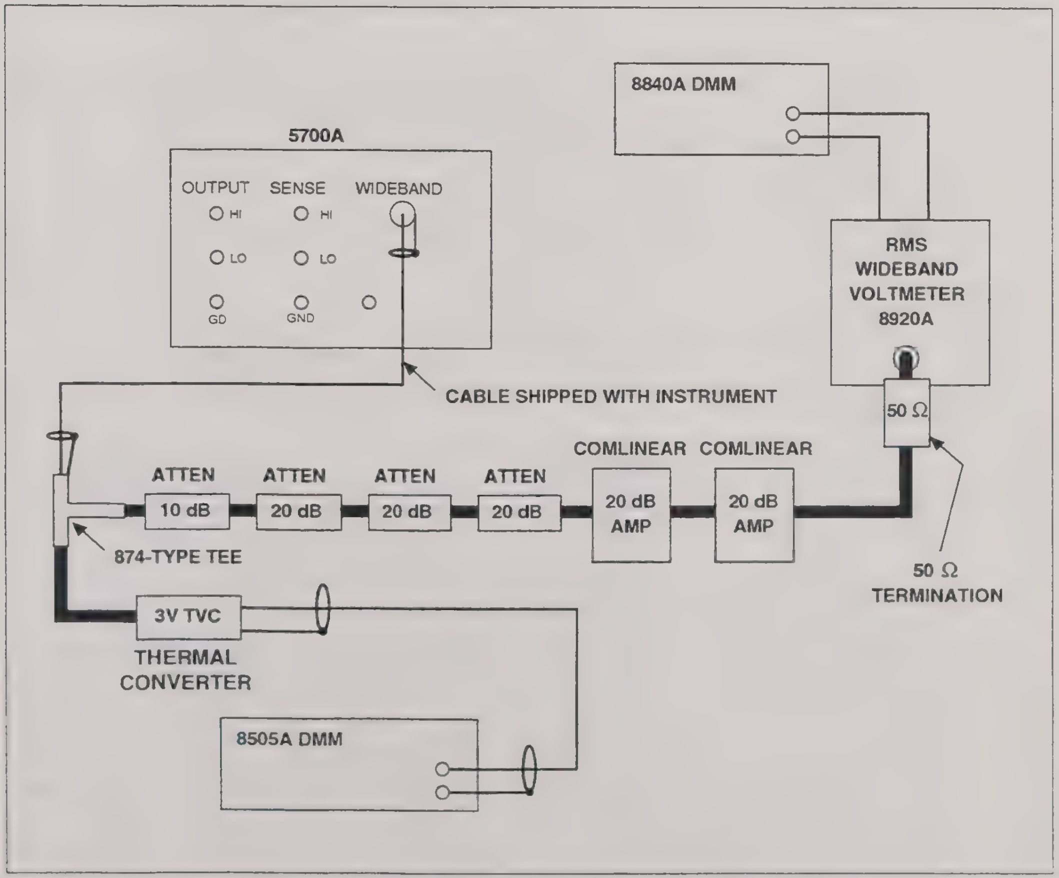


Figure 3-14. Wideband Flatness Calibration Test Setup

5. Use the 5700A output adjustment knob to obtain the 0.90000V reference reading of the rms wideband voltmeter dc DMM. Zero the 8505A DMM connected to the TVC again. Press the 5700A NEW REF button.

NOTE

Do not touch the 8505A DMM connected to the 3V TVC output until the text says to do so, unless you begin the test process at 1 kHz again.

6. Program the frequencies shown on the test record (Table 3-20). For each frequency, adjust the 5700A using the output adjustment knob to obtain a zero on the 8505A DMM that is connected to the TVC output. Then record the rms wideband voltmeter dc DMM reading on the test record (Table 3-20) in the 50Ω DETECTOR CHARACTERIZATION RMS WIDEBAND DC DMM READING column.

NOTE

If any TVC corrections exceed the criteria stated in the step 1 note, use them by offsetting the 8505A DMM by the opposite sign of the reported value. For example, if the reported rf/dc difference is +0.05%, the UUT output (the one that has been nulled on the 8505A DMM connected to the TVC) must be edited down (the 5700A output level goes down and the error goes positive) 0.05% before the rms wideband dc DMM reading can be recorded.

7. The last frequency point is to return to 1 kHz. Adjust the 5700A using the output adjustment knob for a null on the 8505A connected to the TVC and verify that the reading on the rms wideband voltmeter dc DMM is 0.90000V ±0.02%. If it is not, repeat the process beginning at step 2 until this tolerance is met.
8. Set the 5700A to standby.
9. Remove the 3V TVC, Type-874 tee, and 8505A DMM from the setup. Connect the wideband cable directly to the attenuator string input.

3V Range Wideband Flatness Test 3-27.

Proceed as follows to test the 3V range of the wideband ac module:

1. Leave the the test setup connected as described in the last step of the previous procedure.
2. Set the 5700A for a wideband output of 2.7V at 1 kHz. Adjust the 5700A using the output adjustment knob until the rms wideband voltmeter dc DMM reads the same reference reading (previous example was 0.90000V) used in the characterization test. Press NEW REF to reference the 5700A error display to zero.
3. Set the 5700A to the frequencies listed on the test record. At each frequency, adjust the 5700A output level using the output adjustment knob to obtain the characterized rms wideband voltmeter dc DMM reading. Record the 5700A error display for that frequency in the 3V RANGE WIDEBAND FLATNESS TEST ERROR DISPLAY READING column. Verify that the error readings are within the limits shown on the test record. The last frequency is the 1 kHz reference. If the readings do not repeat within 0.02%, do the test process again. Examine the 30 Hz, 120 kHz, and 500 kHz results and verify that when added to the 3V, 1 kHz data from Table 3-19 that each sum is not larger in magnitude than ±0.22%.
4. Enter the 50Ω system characterization data for the 2 MHz, 10 MHz, 20 MHz, 30 MHz points recorded under the WIDEBAND DC DMM CHAR column DATA of the attenuator flatness test record.

Table 3-20. Output Flatness and Attenuator Flatness Test Record

FREQUENCY	50Ω DETECTOR CHARACTERIZATION RMS WIDEBAND DC DMM READING	3V RANGE WIDEBAND FLATNESS TEST ERROR DISPLAY READING	LIMITS	<4:1 STANDARD UNCERTAINTY	REDUCED LIMITS (RSS METHOD)
1 kHz	.90000V	----	----	OK	
10 Hz			0.3%	OK	
30 Hz			0.1%	.05%	0.08%
120 kHz			0.1%	.05%	0.08%
500 kHz			0.1%	.05%	0.08%
2 MHz			0.1%	.05%	0.08%
5 MHz			0.2%	0.1%	0.17%
10 MHz			0.2%	0.1%	0.17%
20 MHz			0.4%	0.15%	0.37%
30 MHz			1.0%	OK	

ATTENUATOR FLATNESS TEST RECORD

FREQ	WIDEBAND DC DMM CHAR DATA	(60 dB) 1.0V OUTPUT	(50 dB) 300 mV OUTPUT	(40 dB) 100 mV OUTPUT	(30 dB) 30 mV OUTPUT	(20 dB) 10 mV OUTPUT	>3 mV LIMIT	REDUCED LIMIT	(10 dB) 3 mV OUTPUT	3 mv LIMIT	(0 db) 1 mV OUTPUT	1 mV LIMIT
1 kHz	0.90000V	0.90000V	0.90000V	0.90000V	0.90000V	0.90000V			0.90000V		0.90000V	
500 kHz							.1%+3μV			0.2%		0.5%
2 MHz							.1%+3μV			0.2%		0.5%
10 MHz							.2%+3μV	0.17%		0.4%		0.7%
20 MHz							.4%+3μV	0.37%		0.6%		0.9%
30 MHz							1%+3μV			1.6%		3.0%
1 kHz	<0.02%Δ	<0.02%Δ	<0.02%Δ	<0.02%Δ	<0.02%Δ	<0.02%Δ			<0.02%Δ		<0.02%Δ	

Attenuator Flatness Test 3-28.

Proceed as follows to test the attenuator flatness:

1. With the equipment still connected as in Figure 3-14, remove the 10 dB attenuator and program the 5700A for a wideband output of 1V, 1 kHz.
2. Use the 5700A output adjustment knob to obtain the rms wideband voltmeter dc DMM reference level of 0.90000V. Press NEW REF to re-reference the error display to zero.
3. Set the 5700A to the frequencies listed on the test record. At each frequency, turn the 5700A output adjustment knob to obtain the rms wideband voltmeter dc DMM characterized data entered on the test record. Record the error display readings and verify that they are within the limits shown on the test record. Verify that when the 500 kHz error is added to the 1V, 1 kHz data from Table 3-19, the sum is not larger in magnitude than ±0.22%.
4. Repeat the preceding process for the remaining ranges by decreasing the range by 10 dB and the total external attenuation by 10 dB for each range. Note that for the next range (0.3V) you will have to remove a 20 dB section and replace the 10 dB section to achieve a 10 dB shift. The total external attenuation is shown in parentheses near each range value.
5. Set the 5700A to standby and disconnect the equipment. For each range verify that the 500 kHz results and the 1 kHz results recorded in Table 3-19 total less than the Table 3-19 LIMIT column for that range. This completes wideband verification.

Wideband Flatness Calibration Procedure 3-29.

This procedure is the only part of full verification that stores calibration constants in the 5700A. This is not a verification test, it is a calibration procedure. Because this part of calibration is recommended to be done only every two years, the same interval as full verification, it is included here and not under Calibration earlier in this section and in Section 7 of the 5700A Operator Manual.

NOTE

The following test uses a non-50Ω thermal voltage converter (TVC) to characterize a 50Ω system. For 5700A wideband flatness calibration to be valid, the 5700A must be connected to a good 50Ω device or system. It is not satisfactory to just parallel the input of the TVC with a good rf 50Ω (especially at frequencies above 10 MHz). However, the TVC will indicate the actual voltage at the center of a Type-874 tee connector in parallel with 50Ω. Therefore, it is valid to calibrate the 50Ω system with the TVC at the other end of a Type-874 tee. **Note that while the TVC is connected, the 5700A wideband output is functioning only as an uncalibrated voltage source.**

NOTE

Before beginning this test, obtain a copy of your 3V TVC test report. Any corrections that exceed the following will have to be applied. Note any corrections that exceed these levels for future reference.

- 0.01% to 2 MHz
- 0.02% to 10 MHz
- 0.04% to 20 MHz
- 0.1% to 30 MHz

Proceed as follows to perform wideband flatness calibration:

1. Connect the equipment as shown in Figure 3-14 and set the rear panel CALIBRATION switch to the ENABLE position.
2. Set the 5700A for 3V, 1 kHz operate. Select WIDEBAND Type "N" connector output by pressing the W BND key.
3. Adjust the 5700A output so the DMM connected to the rms wideband voltmeter dc voltage output reads exactly 1V. Press the NEW REF key.
4. Zero the 8505A DMM (using its offset function) that is connected to the 3V TVC output.
5. At each frequency mentioned below, first adjust the 5700A output until the 8505A DMM connected to the 3V TVC reads 0V, then record the reading of the DMM connected to the rms wideband voltmeter.

NOTE

If any TVC corrections exceed the criteria stated in the previous note, use them by offsetting the 8505A DMM by the opposite sign of the reported value. For example, if the reported rf/dc difference is +0.05%, the UUT output (the one that has been nulled on the 8505A DMM connected to the 3V TVC) must be edited down (the 5700A output level goes down and the error display goes positive) 0.05% before the rms wideband dc DMM reading can be recorded.

Frequency: DMM Reading:	12 kHz, 100 kHz, 500 kHz, 1.1999 MHz, 1.2 MHz,
Frequency: DMM Reading:	2 MHz, 10 MHz, 20 MHz, 30 MHz, 1 kHz*

*The rms wideband DMM reading must return to 1V±*0.02% or the test sequence must be repeated.*

6. Remove the 3V TVC, Type-874 tee, and 8505A DMM from the setup. Connect the wideband cable directly to the attenuator string input.
7. Call up the 5700A Wideband Flatness Calibration routine on the 5700A front panel by pressing the softkey sequence "Setup Menus", "Cal", "Calibration", "Wideband Flat".
8. Enter the present ambient air temperature as prompted, and press ENTER.
9. Wideband Flatness Calibration starts with a 3V output at 1 kHz. Using the 5700A output adjustment knob, adjust the output until the DMM connected to the rms wideband voltmeter output reads exactly 1V; then press ENTER.
10. The wideband output frequency changes to 12 kHz. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 12 kHz in step 5. Press ENTER.

    Repeat this step for each frequency through 30 MHz, adjusting the output each time to match the value recorded in step 5.

11. The 5700A Wideband output changes to 1V at 1 kHz. Remove the 10 dB attenuator from the test setup, leaving a total attenuation of 60 dB. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 1 kHz in step 5. Press ENTER.

    Repeat this step for each frequency through 30 MHz, adjusting the output each time to match the value recorded in step 5.

12. The 5700A Wideband output changes to 300 mV at 1 kHz. Remove a 20 dB attenuator, and replace the 10 dB attenuator on the test set up for a total attenuation of 50 dB. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 1 kHz in step 5. Press ENTER.

    Repeat this step for each frequency through 30 MHz, adjusting the output each time to match the value recorded in step 5.

13. The 5700A Wideband output changes to 100 mV at 1 kHz. Remove the 10 dB attenuator on the test setup for a total attenuation of 40 dB. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 1 kHz in step 5. Press ENTER.

    Repeat this step for each frequency, adjusting the output each time to match the value recorded in step 5. This time, only 1 kHz, 10 MHz, 20 MHz, and 30 MHz points are adjusted.

14. The 5700A Wideband output changes to 30 mV at 1 kHz. Remove another 20 dB attenuator from the test setup for a total attenuation of 30 dB. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 1 kHz in step 5.

    Repeat this step for each frequency through 30 MHz, adjusting the output each time to match the value recorded in step 5.

15. The 5700A Wideband output changes to 10 mV at 1 kHz. Remove the 10 dB attenuator from the test setup for a total attenuation of 20 dB. Use the 5700A output adjustment knob to adjust the output until the DMM reads the voltage that was recorded for 1 kHz in step 5.

    Repeat this step for each frequency, adjusting the output each time to match the value recorded in step 5. This time, only 1 kHz, 10 MHz, 20 MHz, and 30 MHz points are adjusted.

16. Make sure the rear panel CALIBRATION switch is in the ENABLE position, and store the values by pressing a softkey to conclude the Wideband Flatness Calibration procedure. When the display returns to normal, set the rear panel CALIBRATION switch to OFF.

OPTIONAL TESTS 3-30.

These tests may be used in acceptance testing or following repair likely to affect the characteristics tested here. They are not recommended to be done routinely. If the 5700A passes Calibration Performance Verification, you do not need to perform these tests; verification either exercises these functions or is subject to their effects. The Optional Tests include such checks as load regulation, noise, and distortion. Equipment required for the optional tests is listed in Table 3-21.

DC Voltage Load Regulation Test 3-31.

Proceed as follows to test the dc voltage load regulation:

1. Ensure the 5700A is in standby. With the test setup of Figure 3-4, connect the power decade resistor across the 5700A OUTPUT terminals. Connect two shorting links between the 5700A SENSE and OUTPUT terminals and select external sense (EX SNS indicator lit).

2. Set the reference divider to 10V. Set the 5700A output to 10V dc. Set the power decade resistor to 199Ω. Set the 5700A to operate. Adjust the 5700A as necessary to obtain a null on the null detector. Rotate the most significant dial on the power decade resistor to 9. Verify that the null detector indication changes less than ±2 μV. Set 5700A to standby.

3. Repeat load regulation testing at the remaining 5700A outputs shown in Table 3-22.

4. Set the 5700A to standby and disconnect all equipment from the 5700A.

Table 3-21. Equipment Required For DC V Optional Tests

EQUIPMENT	MODEL
DMM	Fluke 8520A
RMS Differential Voltmeter	Fluke 931B
Power Decade Resistor	Clarostat 240C
Differential Amplifier Plug-In	Tektronix 7A22
Oscilloscope Mainframe	Tektronix 7000 Series
DC Voltage Reference Standard	Fluke 732A
Reference Divider	Fluke 752A
Null Detector	Fluke 845A(B or R)
Kelvin-Varley Divider	Fluke 720A

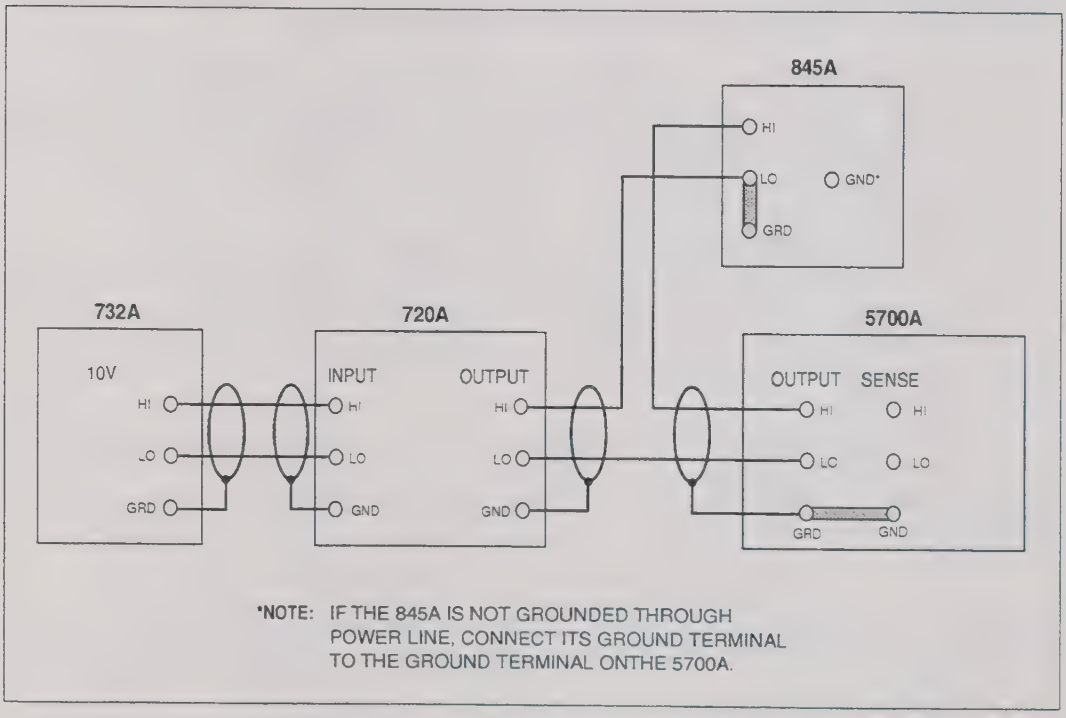
Table 3-22. Load Regulation Test Record

DIV. SETTING	5700A RANGE	5700A OUT/FULL LOAD	CHANGE IN NULL
10V	11V	10V/199Ω	±2 μV
100V	220V	100V/1999Ω	±2 μV
1000V	1100V	1000V/39.99 kΩ	±2 μV

DC Voltage Linearity Test 3-32.

Proceed as follows to test the dc voltage linearity:

1. Self calibrate the Kelvin-Varley (KV) divider as called for in its service manual.
2. Connect the equipment as shown in Figure 3-15.
3. Set the KV dials to zero by using the RANGE LOCK. Set the 5700A to 0V on the 11V range operate. Note the null detector reading. Press OFFSET on the 5700A.
4. Set KV dials to 0.999999X and 5700A for a 10V output.
5. Use the 5700A output adjustment to obtain a null detector reading equal to the reading noted in step 3. Press SCALE on the 5700A.



*NOTE: IF THE 845A IS NOT GROUNDED THROUGH POWER LINE, CONNECT ITS GROUND TERMINAL TO THE GROUND TERMINAL ONTHE 5700A.

Figure 3-15. DC Voltage Linearity Test

Table 3-23. Linearity Test Record

KELVIN-VARLEY SETTING	5700A OUTPUT	NULL DETECTOR READING
0.1	1V	±2.3 µV
0.2	2V	±2.6 µV
0.3	3V	±2.9 µV
0.4	4V	±3.2 µV
0.5	5V	±3.5 µV
0.6	6V	±3.8 µV
0.7	7V	±4.1 µV
0.8	8V	±4.4 µV
0.9	9V	±4.7 µV

6. For each of the KV settings tabulated in Table 3-23, make the required Kelvin Varley setting, and verify that the null detector reads within the limits shown.

DC Voltage Output Noise (10 Hz to 10 kHz) Test 3-33.

Proceed as follows to test the dc voltage output noise that falls in the range 10 Hz to 10 kHz:

1. Connect the equipment as shown in Figure 3-16.
2. Set the Oscilloscope Differential Amplifier controls as shown below.

Low Frequency -3 dB 10 Hz 10 kHz AC (both inputs) 50 µV (Var. to Cal.)
High Frequency -3 dB
Input Coupling
Volts/Div

3. Set the Oscilloscope Time/Div for 2 ms.
4. Set the rms voltmeter range to 1V.
5. Set the 5700A to 2.2V dc, operate. Verify that the reading on the rms voltmeter is less than 150 mV.

NOTE

This test assumes that the amplifier plug-in and scope have a gain equal to 0.5V divided by the input/div. setting, which in the above case is $1x10^4$.

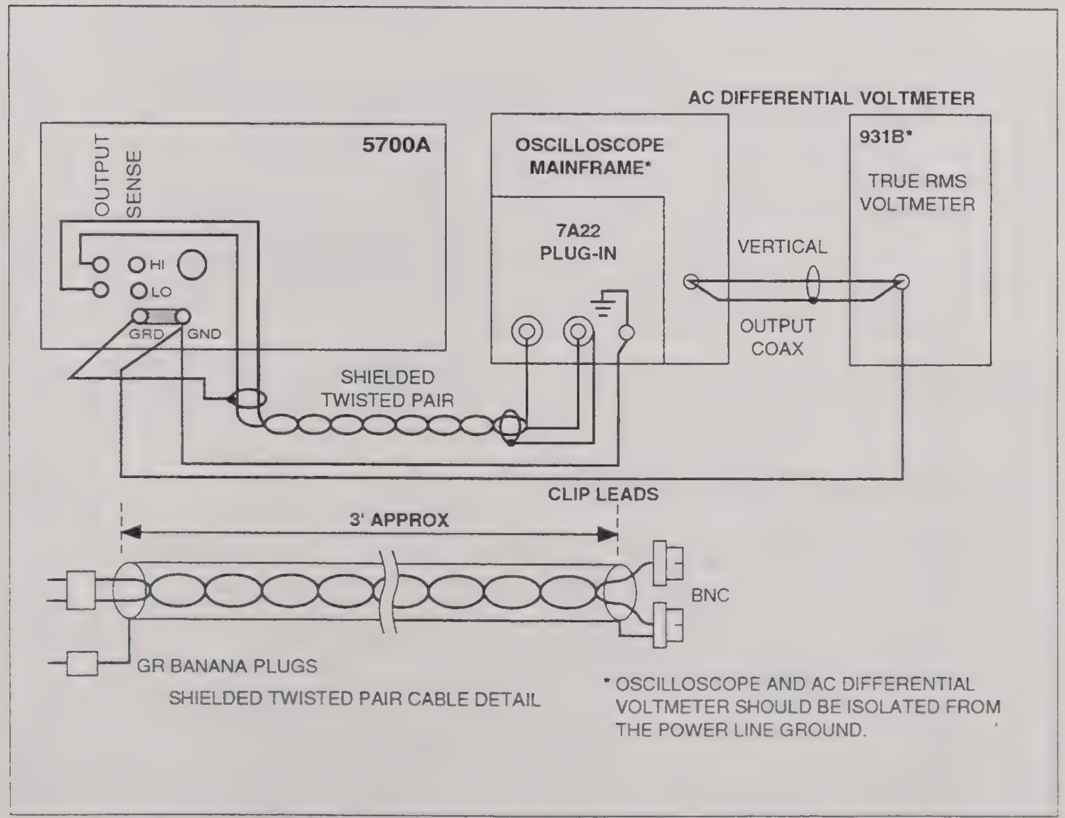


Figure 3-16. DC Voltage Output Noise Test Setup

Table 3-24. DC Voltage Output Noise Test

DIFFERENTIAL AMPLIFIER SENSITIVITY	5700A OUTPUT	MAXIMUM RMS METER READING
50 µV/division	2.2V	150 mV
50 µV/division	10V	500 mV
50 µV/division	20V	500 mV
100 µV/division	200V	750 mV
500 µV/division	1000V	500 mV

6. Repeat the above process for the remaining tabulated settings shown in Table 3-24; verify that the rms meter indicates less than the amount shown for each required output level.
7. Press RESET on the 5700A and disconnect the test configuration.

DC Voltage Output Noise (0.1 to 10 Hz) Test 3-34.

Proceed as follows to test for dc voltage output noise in the range 0.1 to 10 Hz:

1. Place the 8520A DMM into Math Program 8 with the Display Option Register set to register 8.3 (Standard Deviation Computed Variable) as follows:
   a. Press SHIFT, 8, and PROGRAM SELECTION. Then press SHIFT, 0, ., 1, PROGRAM SELECTION, 8, ., 3, PROGRAM DATA.
   b. Set the DMM to 200 mV DC Range, 20 Samples/Second, and 1000 ms Filter.
   c. Set PROGRAMS IN USE to the ON position.
2. Lock the 5700A in the 22V range and set it to 100 mV dc. Place the 5700A in operate.
3. Connect the DMM to the 5700A OUTPUT binding posts and press the DMM reset button once. Verify that after 10 seconds the DMM reads less than 0.0010E-3.
4. Lock the 5700A in the 220V range and set it to 100 mV dc. Place the 5700A in operate.
5. Press the DMM reset button once. Verify that after 10 seconds the DMM reads less than 0.0100E-3.
6. Set the 5700A to standby.

AC Voltage Distortion Test 3-35.

Equipment required for these tests is listed in Table 3-25. Proceed as follows to test for distortion in the ac voltage function.

Table 3-25. Equipment Required for Distortion Tests

EQUIPMENT	MODEL
DMM	Fluke 8520A
Distortion Analyzer	HP 334A or 8903A
Spectrum Analyzer (only for 5700A-03)	HP 8590A
Non-wirewound load resistors	Any (see Table 3-26 for values)

1. Connect the 5700A output terminals to the distortion analyzer.
2. Measure the 5700A distortion at the output voltages and frequencies tabulated in Table 3-26. Verify that the distortion measured is within the limits shown.

Wideband Distortion Testing 3-36.

Proceed as follows to test for distortion in the wideband output function (for units with the Option 5700A-03 Wideband AC Module only).

1. Connect the wideband output terminated in 50Ω to the spectrum analyzer input.

NOTE

If the spectrum analyzer input impedance is 50Ω, do not use a separate termination.

2. With 0 dBm output programmed from the 5700A wideband output, select frequencies over the band of 1 MHz to 30 MHz and verify that use the spectrum analyzer to verify that any harmonics are below -40 dBm for fundamentals up to 10 MHz and below -34 dBm for fundamentals of 10 MHz and above.
3. Disconnect the equipment from the 5700A.

AC Voltage Overshoot Test 3-37.

Proceed as follows to test for ac voltage overshoot:

1. Connect the 5700A output to a properly compensated 10:1 probe.
2. AC couple the oscilloscope and set the sweeptime to a fairly low sweeptime (approximately 1 sec/div).
3. Set the 5700A to 7.07V at 1 kHz, and press OPR/STBY.
4. Set the scope vertical sensitivity for 0.05V/div. Offset the trace vertically until you can see the top of the waveform at the approximately center of the display (must be at least 2-3 divisions down from the top of the scope graticule).
5. Set the 5700A to standby and then back to operate. Verify that any overshoot visible on the oscilloscope display is less than 1.5 divisions (approximately 10% of the peak value).
6. Repeat the test at 100 Hz and 100 kHz. This completes the Optional Tests.

Table 3-26. AC V Test Summary

5700A OUTPUT	LOAD RESISTORS	FREQUENCY	MAX. DISTORTION
2V	100Ω, 1/8W	10 Hz, 20 Hz	0.054%
		1 kHz, 20 kHz, 50 kHz,	0.044%
		100 kHz, 200 kHz, 500 kHz	0.355%
20V	1 kΩ, 1/2W	10 Hz, 20 Hz	0.0535%
		20 kHz, 100 kHz	0.0385%
		200 kHz, 500 kHz	0.304%
200V	10 kΩ, 5W	10 Hz, 20 Hz	0.055%
		50 kHz, 100 kHz	0.1065
NOTE 300V	15 kΩ, 5W	40 Hz	0.1%
NOTE 300V	15 kΩ, 5W	50 kHz	0.3%
NOTE 300V	15 kΩ, 5W	70 kHz	0.4%

NOTE: The 5700A maximum volt-Hertz product is (2.2×10^7). The 300V level assumes that a Fluke 5725A Amplifier is attached.

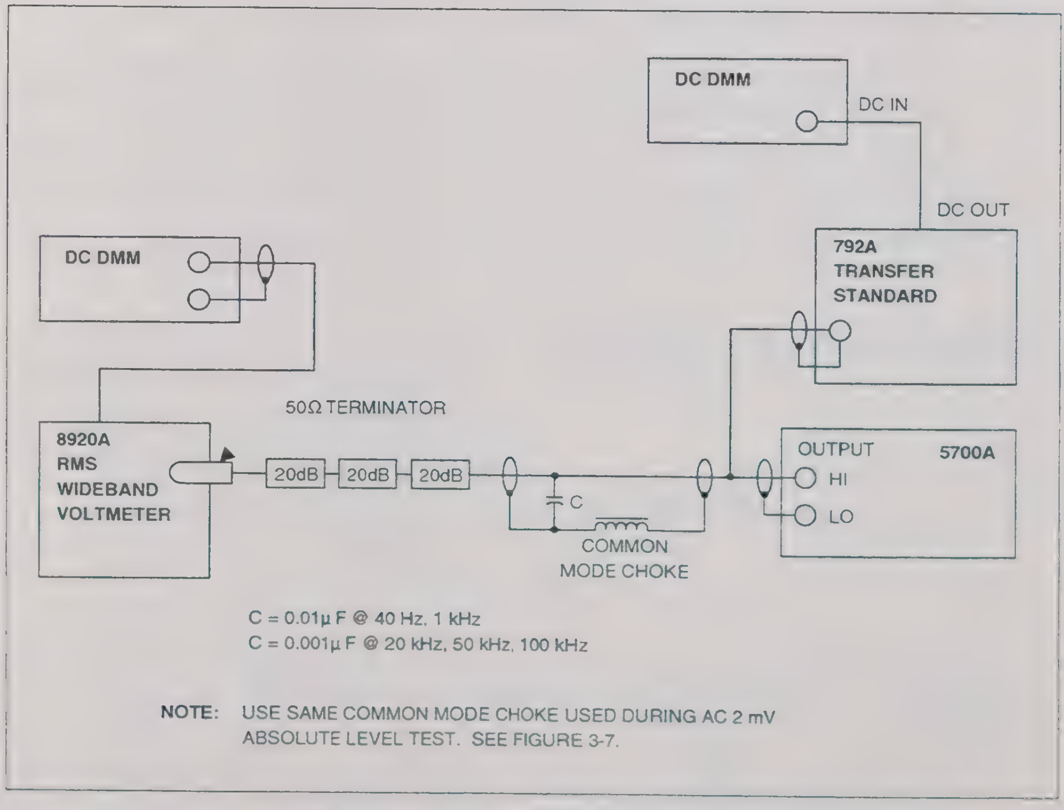
AC 2 mV Range Flatness Test 3-38.

The flatness of the 2 mV range is checked by using the 5700A 2V range monitored by the 792A transfer standard and 60 dB of attenuation to characterizing a rms wideband voltmeter dc DMM combination. This set up also requires a filter capacitor and a common mode choke. Table 3-27 lists equipment required for this test. Proceed as follows:

1. Set up the equipment as shown in Figure 3-17. Use three 20 dB attenuators in series and a 0.01 µF capacitor across the input of the rms wideband voltmeter.
2. Set the 5700A for a 1.9V output at 1 kHz.
3. Allow three minutes for the setup to stabilize and then adjust the 5700A output using the output adjustment knob until the dc DMM connected to the rms wideband voltmeter reads the same as the "CHARACTERIZED 1.9 MV READING" recorded in Table 3-11. Press the 5700A NEW REF key to reference the output.

Table 3-27. Equipment Required for the AC 2 mV Range Flatness Test

EQUIPMENT	MODEL
RMS Wideband Voltmeter	Fluke 8920A
DMM	Fluke 8505A
AC/DC Transfer Standard	Fluke 792A
50Ω Feedthrough Termination	Fluke P/N 853429
20 dB RF Attenuator (Qty. 3)	Narda 777C-20
Common-Mode Choke	(Construction details in Figure 3-7.)



C = 0.01µ F @ 40 Hz, 1 kHz
C = 0.001µ F @ 20 kHz, 50 kHz, 100 kHz

NOTE: USE SAME COMMON MODE CHOKE USED DURING AC 2 mV ABSOLUTE LEVEL TEST. SEE FIGURE 3-7.

Figure 3-17. AC 2 mV Flatness Test Setup

4. Zero the 792A Transfer Standard output dc DMM usoing the DMM offset function.
5. Set the 5700A to 40 Hz. Adjust the 5700A using the output adjustment knob to maintain a null on the 792A output dc DMM. Record the dc DMM reading in Table 3-28.
6. Replace the 0.01 μF capacitor with a 0.001 μF capacitor. Set the 5700A to 20 kHz, 50 kHz, and 100 kHz, repeating the process of step 5.
7. Remove the 0.001 μF capacitor and set the 5700A to 300 kHz and 1 MHz, repeating the process of step 5.
8. Reinstall the 0.01 μF capacitor and set the 5700A to the 1 kHz reference and check for repeatability within ±0.03%.
9. Remove the rf attenuators, 50Ω load, and 792A Transfer Standard from the setup and connect the rms wideband voltmeter dc DMM combination directly to the 5700A output.
10. Set the 5700A for 1.9 mV at 40 Hz and 20 kHz. At each frequency adjust the output, using the output adjustment knob, until the dc DMM reading is equal to the previously characterized reading recorded in step 5. Verify that the error display reading is within the limits shown in Table 3-29.
11. Replace the 0.01 μF capacitor with a 0.001 μF capacitor. Repeat the previous step at 50 kHz and 100 kHz. At each frequency edit the output until the dc DMM read the same as recorded in step 6.
12. Remove the 0.001 μF capacitor. Repeat step 11 at 300 kHz and 1 MHz. At each frequency edit the output until the dc DMM read the same as recorded in step 7.

Table 3-28. Characterizing the RMS Wideband Voltmeter/DC DMM Combination

FREQUENCY	DC DMM READING
1 kHz	Same as recorded in the 1 kHz verification
10 Hz	
20 Hz	
40 Hz	
20 kHz	
50 kHz	
100 kHz	
300 hHz	
500 kHz	
1 MHz	

Table 3-29. Test Record for Flatness Check of the ac 2 mV Range

FREQUENCY	UUT ERROR DISPLAY READING	LIMITS
10 kHz		
20 kHz		
40 Hz		±0.26%
1 kHz		
20 kHz		±0.26%
50 kHz		±0.29%
100 kHz		±0.49%
300 kHz		±0.87%
500 kHz		
1 MHz		±1.83%

ALTERNATE TESTS 3-39.

The following two test procedures are alternate methods for testing the 20 mV and 200 mV ac voltage ranges and the 2 mA and 200 µA ac current ranges. The millivolt test presented here is for labs without a direct measuring transfer standard for the 20 mV and 200 mV ranges (such as the Fluke 792A AC/DC Transfer Standard). The milliampere tests are also for labs without a 792A AC/DC Transfer Standard.

Absolute Level Verification at 1 kHz (200 mV and 20 mV) 3-40.

Proceed as follows to do the alternate test for the absolute level of the millivolt ranges at 1 kHz:

1. Connect the equipment as shown in Figure 3-18.
2. Set the 5700A for a 2V, 1 kHz output and use the output adjustment knob to adjust the error display for the CALCULATED ERROR reading recorded for 2V, 1 kHz in the Output Level Tests for AC Voltage Ranges 2V and Above (Table 3-10).
3. Set the ratio transformer to 0.1, and adjust the rms differential voltmeter dials for a null. Record the dial setting as the 200 mV reading on the test record (Table 3-30).
4. Set the ratio transformer to 0.01 and adjust the rms differential voltmeter dials for a null. Record the dial setting as the 20 mV reading on the test record.
5. Disconnect the ratio transformer from the setup. Use the characterized rms differential voltmeter to measure and record the 5700A 1 kHz outputs at each characterized 1 kHz voltage level of 20 mV and 200 mV. That is, adjust the 5700A using the output adjustment knob to obtain the characterized reading on the rms differential voltmeter. Record the 5700A error display in each case and verify it is within the limits shown.
6. Proceed as follows to test for frequency response. Connect the equipment as shown in Figure 3-19.

NOTE

The transfer standard used must meet the specification requirements at 2V of item 8 of Table 3-32.

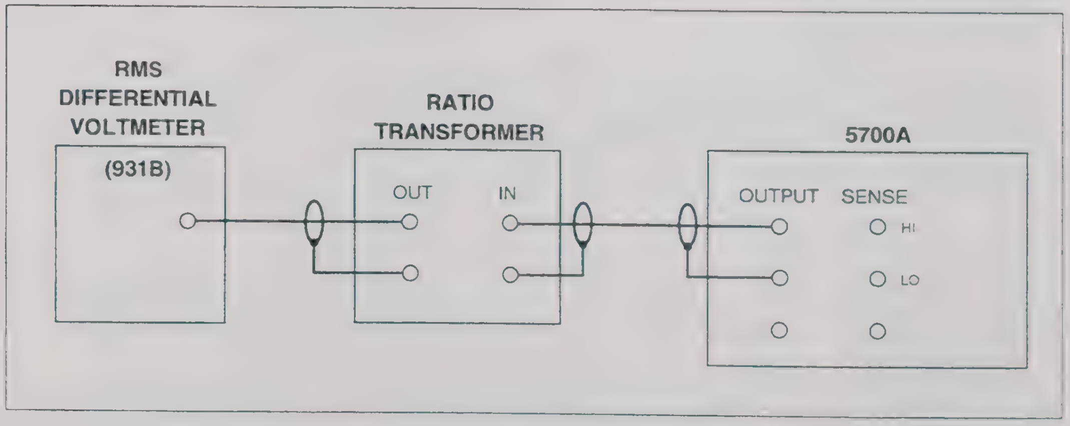


Figure 3-18. Absolute Level Verification at 1 kHz (200 mV and 20 mV)

Table 3-30. Alternate AC Voltage Millivolt Ranges Test Record

1 KHZ LEVEL VERIFICATION (200 mV AND 20 mV RANGES)			
UUT OUTPUT	**RATIO TRANS. SETTING**	**931 200 mV READING**	**931 20 mV READING**
2V @ 1 kHz	0.1	N/A	N/A
2V @ 1 kHz	0.01		
UUT OUTPUT	**UUT ERROR DISPLAY**	**LIMITS**	
200 mV @ 1 kHz		±150 ppm	
20 mV @ 1 kHz		±410 ppm	
FREQUENCY RESPONSE TESTING (200 mV AND 20 mV RANGES)			
CHARACTERIZING 200 mV LEVEL OF RMS DIFF. VOLTMETER:			
FREQ.	**RMS DIFF. VOLTMETER READING**		
1 kHz	Null		
40 Hz			
20 kHz			
50 kHz			
100 kHz			
300 kHz			
1 MHz			
1 kHz	Return to Null ±0.003%		
CHARACTERIZING 20 mV LEVEL OF RMS DIFF. VOLTMETER:			
FREQ.	**RMS DIFF. VOLTMETER READING**		
1 kHz	Null		
40 Hz			
20 kHz			
50 kHz			
100 kHz			
300 kHz			
1 MHz			
1 kHz	Return to Null ±0.01%		
20 mV OUTPUT ACCURACY:			
FREQ.	**UUT ERROR DISPLAY**	**LIMITS**	
10 Hz		±850 ppm	
20 Hz		±520 ppm	
20 kHz		±410 ppm	
50 kHz		±670 ppm	
100 kHz		±0.13%	
300 kHz		±0.195%	
1 MHz		±0.48%	
200 mV OUTPUT ACCURACY:			
FREQ.	**UUT ERROR DISPLAY**	**LIMITS**	
10 Hz		±630 ppm	
20 Hz		±270 ppm	
40 Hz		±150 ppm	
20 kHz		±150 ppm	
50 kHz		±380 ppm	
100 kHz		±0.115%	
300 kHz		±0.19%	
1 MHz		±0.38%	

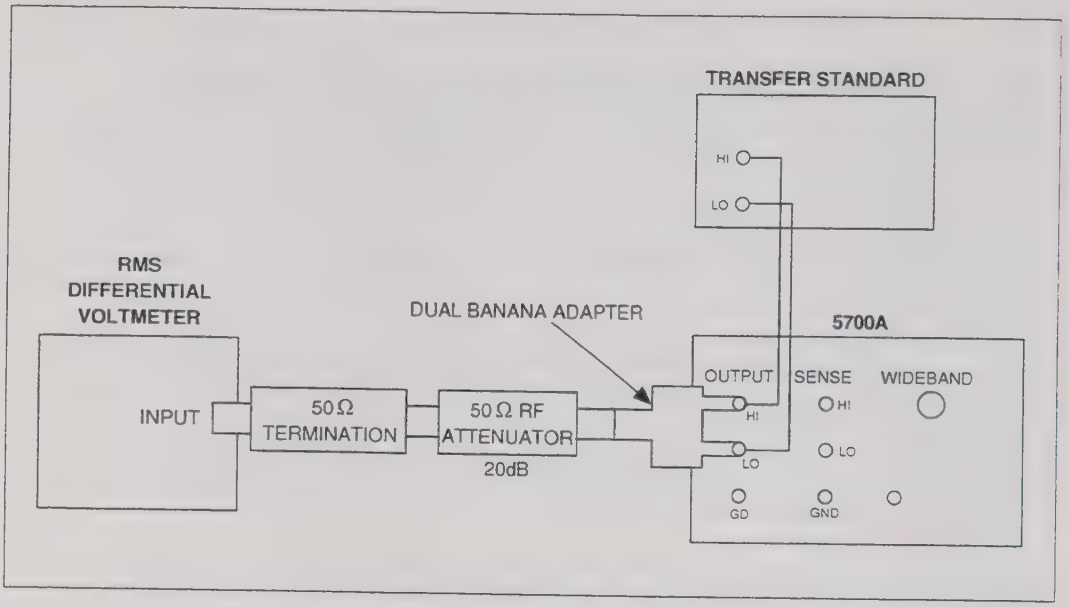


Figure 3-19. 200 mV and 20 mV Frequency Response Characterization(Aternate test)

7. Set the 5700A for a 2V, 1 kHz output. Set the rms differential voltmeter dials to the previously characterized 200 mV, 1 kHz setting. Adjust the 5700A output using the output adjustment knob for a null on the rms differential voltmeter. Press the NEW REF key on the 5700A and obtain a reference null on the output of the transfer standard.

8. Set the 5700A to each of the following frequencies: 10 Hz, 20 Hz, 40 Hz, 20 kHz, 50 kHz, 100 kHz, 300 kHz, 500 kHz, and 1 MHz. At each frequency adjust the 5700A using the output adjustment knob to maintain a null on the transfer standard. Record the rms differential voltmeter offset in percent up to 100 kHz. At frequencies higher than 100 kHz, set the differential voltmeter dials for a null and record the dial settings in Table 3-30.

9. Return the 5700A to the 1 kHz reference output and verify that the differential voltmeter and transfer standard come back to the original null within ±0.003% (30 ppm). If not, repeat the process until adequate repeatability is attained.

10. Add a second 20 dB attenuator to the setup of Figure 3-19 and repeat the entire process of steps 7 through 9 to obtain 20 mV rms differential voltmeter corrections. Again, go back to the 1 kHz Level Verification 931 20 mV READING result to obtain the precise rms differential voltmeter reading to use as a reference.

11. Disconnect the transfer standard, attenuators, and termination from the setup and connect the 5700A output directly to the rms differential voltmeter input.

12. Set the 5700A for a 200 mV output at all frequencies listed under 200 mV OUTPUT ACCURACY on the test record (Table 3-30). At each frequency, use the 5700A output adjustment knob to obtain the characterized 200 mV rms differential voltmeter reading. Verify that the 5700A error display you record is within the limits shown.

13. Repeat step 12 for a 5700A output of 20 mV.

14. Set the 5700A to standby and disconnect the rms differential voltmeter.

Alternate 2 mA and 200 μA AC Current Test 3-41.

Proceed as follows to do the alternate test for 2 mA and 200 μA ac current ranges:

1. Connect the equipment as shown in Figure 3-20.
2. Set the 5700A for precisely 2 mA dc using the correction from previous data recorded (i.e. set the error display to the value previously recorded for +2 mA).
3. Record the DMM reading on the line labeled DMM 2 mA DC VOLTAGE READING in the test record (Table 3-31).

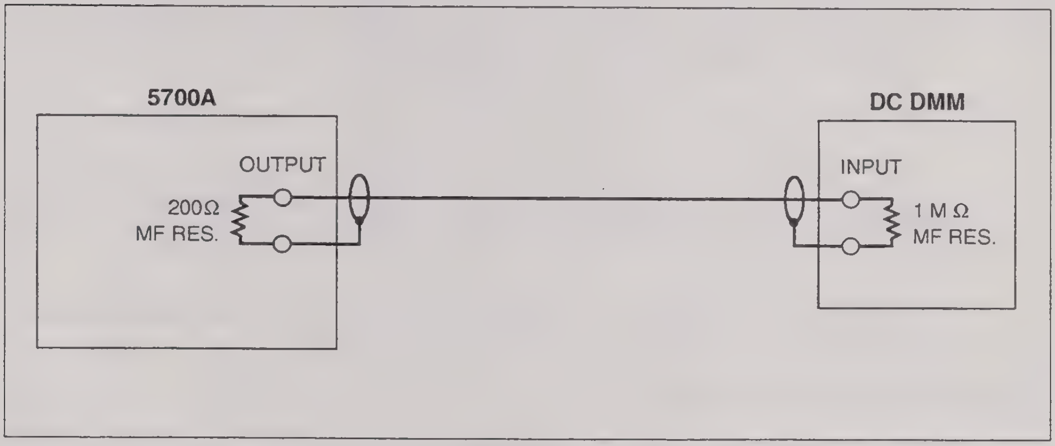


Figure 3-20. 2 mA Reference DC Current Test Setup

Table 3-31. Alternate 2 mA and 200 μA AC Current Test Record

DMM 2 mA DC READING =		
CORRECTED 2 mA DC VOLTAGE =		
EXPECTED 2 mA AC READING (VOLTAGE)	ACTUAL 2 mA ERROR (IN PERCENT)	ERROR LIMITS
10 Hz =		±725 ppm (±0.073%)
20 Hz =		±400 ppm (±0.04%)
40 Hz =		±160 ppm (±0.016%)
1 kHz =		±160 ppm (±0.016%)
5 kHz =		±850 ppm (±0.085%)
10 kHz =		±0.21%
DMM 200 μA DC READING =		
CORRECTED 200 μA DC VOLTAGE =		
EXPECTED 200 μA AC READING (VOLTAGE)	ACTUAL 200 μA ERROR (IN PERCENT)	ERROR LIMITS
10 Hz =		±850 ppm (±0.085%)
20 Hz =		±505 ppm (±0.05%)
40 Hz =		±240 ppm (±0.024%)
1 kHz =		±240 ppm (±0.024%)
5 kHz =		±0.575%
10 kHz =		±2.44%

4. Remove both resistors from the setup and set the 5700A dc voltage output to obtain the DMM reading recorded in step 3. Record the 5700A dc voltage output setting as the CORRECTED 2 mA DC VOLTAGE.

5. Connect the rms differential voltmeter in place of the dc dmm. Set the rms differential voltmeter dials to indicate the voltage just recorded as the CORRECTED 2 mA DC VOLTAGE.

6. Set the 5700A ac voltage output level to the voltage reading set on the rms differential voltmeter dials. Set the 5700A frequency to each of 10 Hz, 20 Hz, 40 Hz, 1 kHz, 5 kHz, and 10 kHz. At each frequency, without touching the rms differential voltmeter dials, record the rms differential voltmeter null meter offset in percent in the EXPECTED 2 mA AC READING column.

7. Connect the equipment as shown in Figure 3-21.

8. Set the 5700A to the output level and frequencies used in step 6. At each point, adjust the 5700A output adjustment knob to obtain the EXPECTED 2 mA AC READING. Record the UUT error display indication for each point. Verify that each is within the limits shown.

9. Repeat steps 1 through 8 to test the 200 µA ac current range using the 2 kΩ metal film resistor in place of the 200Ω metal film resistor.

MINIMUM USE REQUIREMENTS 3-42.

Table 3-32 defines specifications for test equipment needed for tests in this section of the manual. If the specific test equipment called for in these tests is not available, you can substitute equipment that meets these specifications.

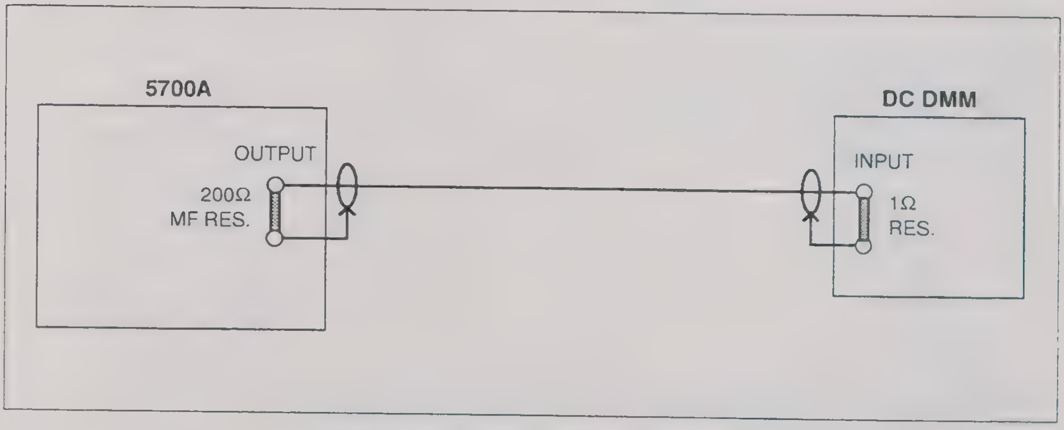


Figure 3-21. 2 mA AC Current Setup

Table 3-32. Minimum Use Requirements

ITEM NO.	DESCRIPTION	MINIMUM USE SPECIFICATIONS	RECOMMENDED EQUIPMENT
		CALIBRATION EQUIPMENT	
1.	Voltage Reference	10V nominal, true value certified to within ±1.5 ppm	Fluke 732A
2.	Resistance Standard	1Ω nominal, true value certified to Standards within 6 ppm Series, 1Ω and 10 kΩ 10 kΩ nominal, true value certified to within 3.5 ppm	Fluke 742A Series, 1Ω and 10 kΩ
		CALIBRATION VERIFICATION EQUIPMENT	
3.	Reference Voltage Divider	Range uncertainty: 100:1, 1 kV input, ±0.5 ppm 10:1, 100V input, ±0.2 ppm	Fluke 752A
4.	Null Detector	Leakage resistance to case: 10^{12}Ω min. Resolution: 3 µV full scale	Fluke 854A
5.	Low Thermal EMF Cables	Plug-in or spade lug. Copper or gold-flashed copper (two cables per set, two sets required).	Fluke 5440-7002
6.	Digital Multimeter	DC Voltage Range: 0.1 to 10V Resolution and short-term stability: ±2 ppm Resistance range: 1Ω to 10 MΩ Resolution and short-term stability: ±20 uΩ at 1Ω, 1.9Ω ±5 ppm at 10Ω, 19Ω ±2 ppm at 100Ω to 1.9 MΩ ±4 ppm at 10 MΩ, 19 MΩ	Fluke 8505A
		Burst memory and math capabilities	Fluke 8520A
7.	Current Source	Range: 10 mA and 100 mA Typical short-term stability: ±15 ppm for 5 minutes	Fluke 5100B, 5700A, or EDC CR103/J
8.	AC/DC Transfer Standard	Ranges: 1 kV, 220V, 70V, 22V, 2.2V, 700 mV, 220 mV, and 22 mV Uncertainty of ac/dc difference in Table 3-33	Fluke 792A
9.	Transfer Standard	Use with A40 series shunts for ac current verification.	Fluke 540B
10.	RMS Wideband Voltmeter	Range: 2 mV, analog dc output	Fluke 8920A
11.	Ratio Transformer	Range: 2V input at 1 kHz Uncertainty at ratio settings: 0.001 ±250 ppm	ESI DT72A
12.	RF Attenuators	50Ω impedance ±1% at dc RF attenuation rated to 1 GHz minimum Flatness to 30 MHz: negligible error 20 dB (3 ea.), 10 dB (1 ea.) (Note 2)	Narda 777C-10 (10 dB) Narda 777C-20 (20 dB)
13.	Frequency Counter	10 Hz to 30 MHz ±0.002%	Philips PM 6669

Table 3-32. Minimum Use Requirements (cont)

ITEM NO.	DESCRIPTION	MINIMUM USE SPECIFICATIONS	RECOMMENDED EQUIPMENT
14.	Resistors Standard	0.1Ω nominal, true value certified to within 20 ppm, rated for 2A dc 1Ω nominal, true value certified to within 6 ppm 1.9Ω nominal, true value certified to within 6 ppm 10Ω nominal, true value certified to within 6 ppm 1 kΩ nominal, true value certified to within 5.5 ppm 10 kΩ nominal, true value certified to within 3.5 ppm 19 kΩ nominal, true value certified to within 4 ppm 10 MΩ nominal, true value certified to within 15 ppm 19 MΩ nominal, true value certified to within 28 ppm	L&N 0.1Ω 40-Series Fluke 742A Series or equivalent
15.	DC Shunt (Note 3)	Range: 10A Uncertainty: ±0.008%	Fluke Y5020
16.	AC/DC Shunt	Ranges: 10A, 2A, 200 mA, and 20 mA, 40 Hz to 10 kHz ±40 ppm, 40 Hz to 5 kHz ±100 ppm, 5 kHz to 10 kHz	Fluke A40
16A.	Metal Film Resistors	Values: 200Ω, 2 kΩ, and 1 MΩ Temperature Co: T9 or better Power Rating: 1/4 Watt Tolerance: ± 1%	Stock Items
17.	Differential Amplifier	Sensitivity: 5 µV rms Bandwidth selectable to 10 kHz	Tektronix 7A22 w/7000-Series Mainframe
18.	Distortion Analyzer	Range: 2V to to 300V Frequency: 10 Hz to 600 kHz	HP 334A or HP8903A
19.	Thermal Voltage Converter (TVC)	Range: 3V, 10 Hz to 30 MHz AC/DC difference: to 1 MHz: ±0.05% to 10 MHz: ±0.1%, to 20 MHz: ±0.15% to 30 MHz: ±0.25%	Fluke A55
20.	Kelvin-Varley Voltage Divider	Ratio uncertainty: ±0.1 ppm of input	Fluke 720A
21.	HV Decoupling Network	Used to decouple voltage above 2V to measure dc V output noise to 15 kHz bandwidth.	See Figure 3-8
22.	HF Spectrum Analyzer (used in optional test for wideband distortion)	Freq. Range: 2 MHz to 120 MHz Input Level: 3V (+20 dBm to -60 dBm)	HP 8590A
23.	RMS Differential Voltmeter (in optional test for wideband distortion) (Note 4)	Input Resistance: 1 MΩ ±1%, shunted by less than 8pF. Input level: 0 to 1V ac to 10 kHz Stability: ±10 ppm short term at 400 mV input level	Fluke 931B (Fluke 8506A may be used)

NOTE 1: A Fluke 8505A DMM may be used for all but the 1Ω and 1.9Ω values. For those values using the 8500A, a test metho using an external current source is used for low-value resistance.

NOTE 2: The attenuators are needed only for testing the Wideband AC Voltage Module (Option 5700A-03).

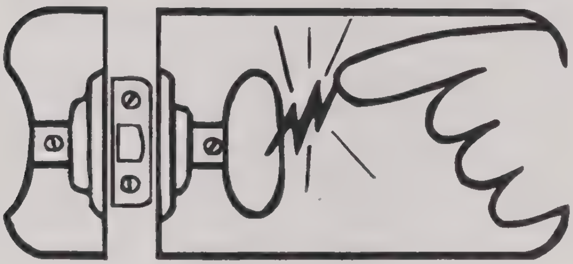
NOTE 3: Needed only for 5725A Amplifier testing. Not required if a Fluke 792A AC/DC Transfer Standard is available.

NOTE 4: Not required if a Fluke 792A AC/DC Transfer Standard is available.

static awareness

A Message From

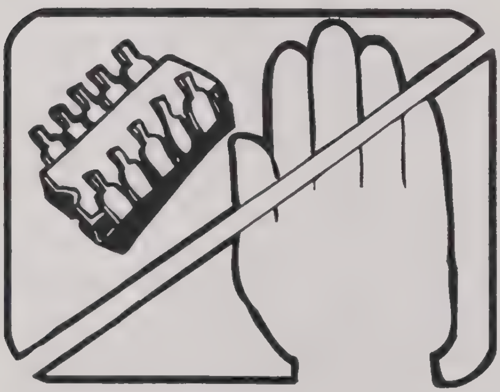
Fluke Corporation



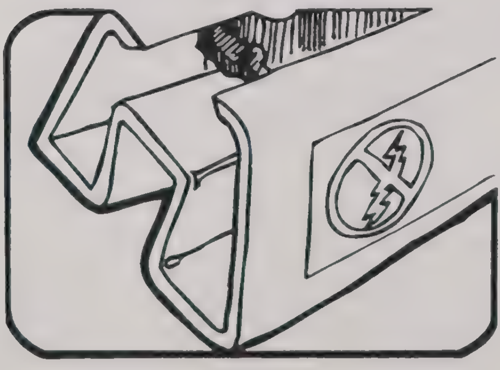
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Leaning the guidelines for handling them.
3. Using the procedures, packaging, and bench techniques that are recommended.

The following practices should be followed to minimize damage to S.S. (static sensitive) devices.

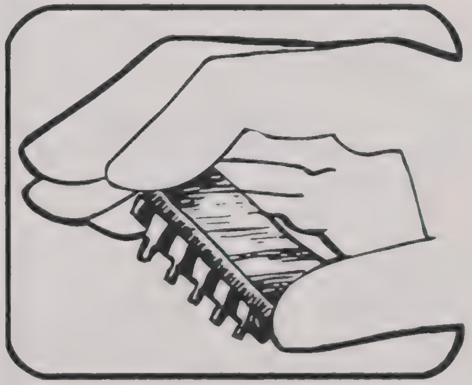


1. MINIMIZE HANDLING

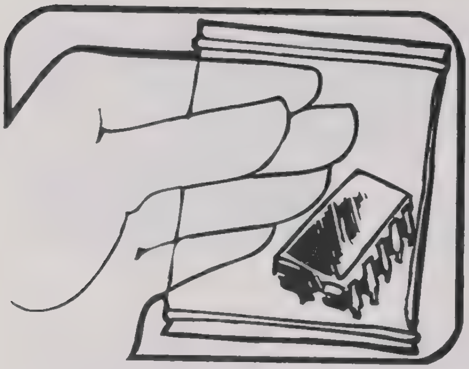


2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.

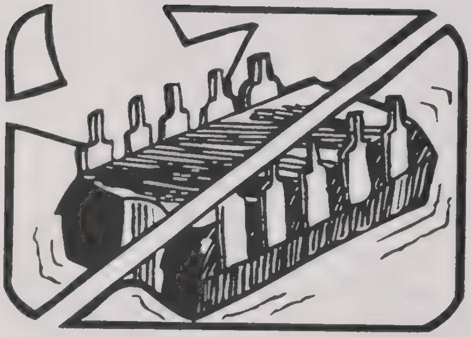
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



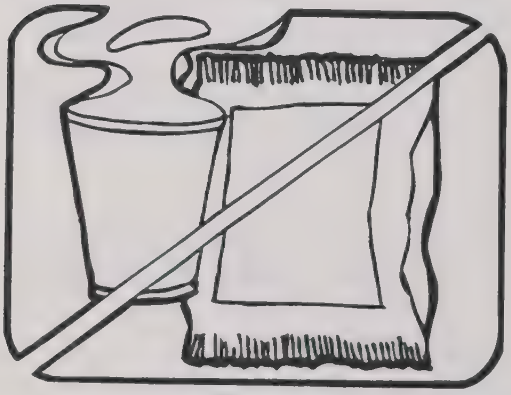
4. HANDLE S.S. DEVICES BY THE BODY.



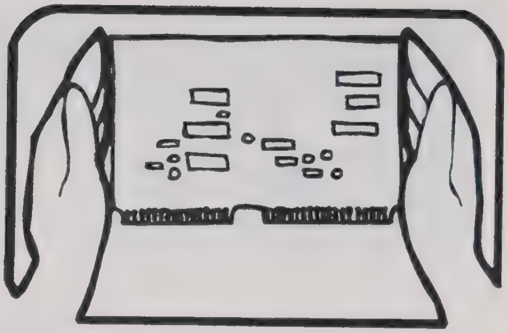
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT.



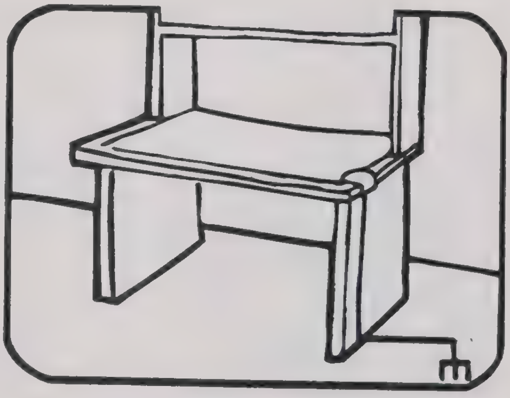
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE.



7. AVOID PLASTIC,VINYL AND STYROFOAM® IN WORK AREA.



8. WHEN REMOVING PLUG-IN ASSEMBLIES HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS PROTECT INSTALLED S.S. DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION.

10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

11. ONLY GROUNDED-TIP SOLDERING IRONS SHOULD BE USED.

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Section 4

Maintenance

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INTRODUCTION 4-1.

This section covers procedures that do not fall into the category of troubleshooting or repair. This includes access procedures, installation of the Wideband module (Option -03), periodic cleaning, and other special service procedures.

CLEANING THE AIR FILTER 4-2.

CAUTION

Damage caused by overheating may occur if the area around the fan is restricted, the intake air is too warm, or the air filter becomes clogged.

The air filter must be removed and cleaned every 30 days or more frequently if the calibrator is operated in a dusty environment. The air filter is accessible from the rear panel of the calibrator.

To clean the air filter, refer to Figure 4-1 and proceed as follows:

1. Remove the filter element.
   a. Unscrew the knurled screw at the top of the air filter (counterclockwise).
   b. Pull the air filter retainer downward; it hinges at the bottom.
   c. Remove the filter element.
2. Clean the filter element.
   a. Wash the filter element in soapy water.
   b. Rinse the filter element in fresh running water.
   c. Shake out the excess water, then allow the filter element to dry thoroughly before reinstalling it.
3. Reinstall the filter element, its retainer, and the knurled screw.

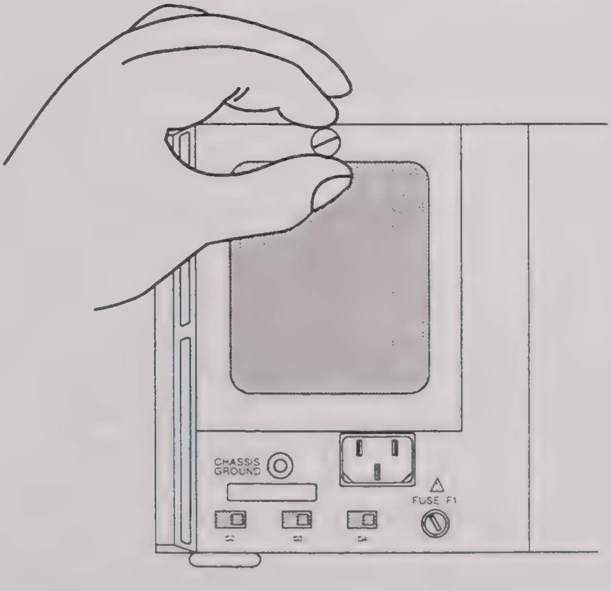


Figure 4-1. Air Filter

GENERAL CLEANING 4-3.

To keep the 5700A looking like new, clean the case, front panel keys, and lens using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the calibrator.

CLEANING PCA'S 4-4.

Printed circuit assemblies only need cleaning after repair work. After soldering on a pca, remove flux residue using isopropyl alcohol and a cotton swab.

ACCESS PROCEDURES 4-5.

WARNING

SERVICING DESCRIBED IN THIS SECTION IS TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

Top and Bottom Covers 4-6.

Check that power is not connected to the 5700A; the power control must be off, and the line power cord must be disconnected. Top and bottom covers are each secured with eight Phillips head screws (four front, four rear).

Digital Section Cover 4-7.

The Digital Section is accessed through one top cover that is secured by six Phillips head screws.

Analog Section Covers 4-8.

The Analog Section is enclosed with separate covers on top and bottom. The top cover is secured with seven Phillips head screws. The bottom Analog Section cover is secured with eight Phillips head screws (three short, five longer).

Rear Panel Removal and Installation 4-9.

Detach the Rear Panel by removing the six hex head screws (three on each rear handle side) and the two Phillips head screws found along the side of the Fan Assembly. Refer to Figure 4-2 for screw locations.

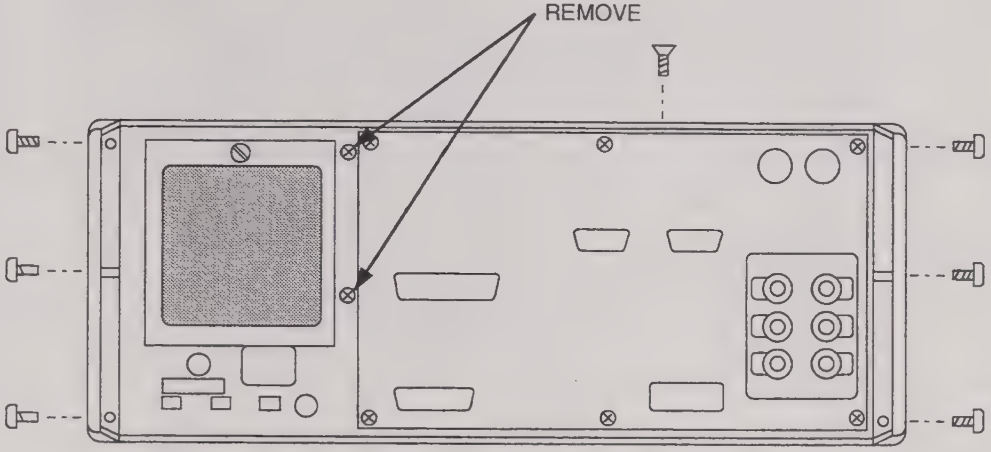
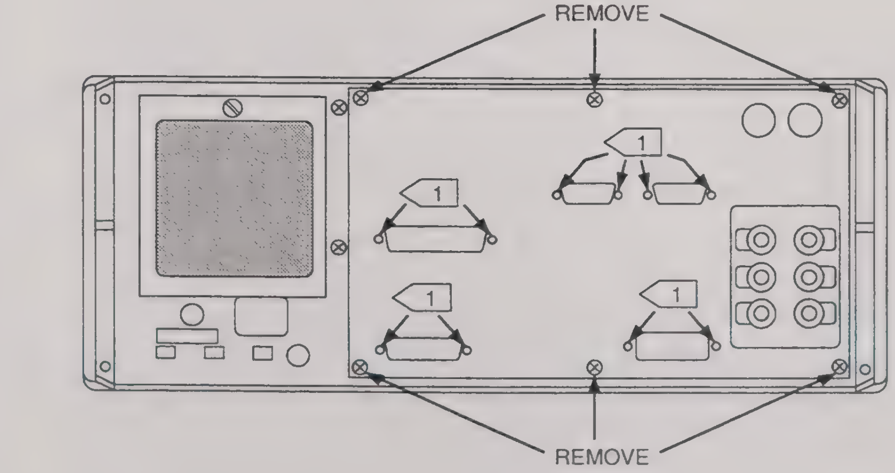


Figure 4-2. Rear Panel Removal



1 REMOVE FACK SCREWS TO SEPARATE THE REAR PANEL CIRCUIT BOARD FROM THE METAL HOUSING.

Figure 4-3. Rear Panel Assembly Access

Rear Panel Assembly Access 4-10.

Refer to Figure 4-3 during the following procedure:

1. Remove the six securing screws for the Rear Panel assembly housing.
2. Gently pull the rear panel housing from the Rear Panel.
3. Allow the rear panel housing to lay flat on the work surface by removing the two ribbon cables from the Rear Panel board.
4. Remove the two nuts at TB1 and TB2 on the paddle board; separate the associated wires from the paddle board.
5. Remove P11 from J11. Then remove the two paddle board mounting screws and separate the paddle board from the Rear Panel assembly.
6. Remove the jack screws for each connection on the rear panel housing, then gently lift the Rear Panel assembly out from the housing.
7. Reverse this procedure to install the Rear Panel assembly.

Front Panel Removal and Installation 4-11.

Refer to Figure 4-4 during the following procedure:

1. Remove the 5700A top and bottom covers.
2. Remove the single screw at the top of the Front Panel and the six hex screws on the front handle sides. Then grasp both handles and gently tilt the Front Panel down and away from the mainframe, disengaging the green power button. Position the Front Panel on its handles, in front of the instrument.
3. If you need to completely detach the Front Panel from the 5700A, one, or possibly two, cables must be disconnected. The output cable must be detached in all configurations. If the Wideband Option is installed, you must also detach the related connector from the Front Panel.

Reverse this procedure to install the Front Panel.

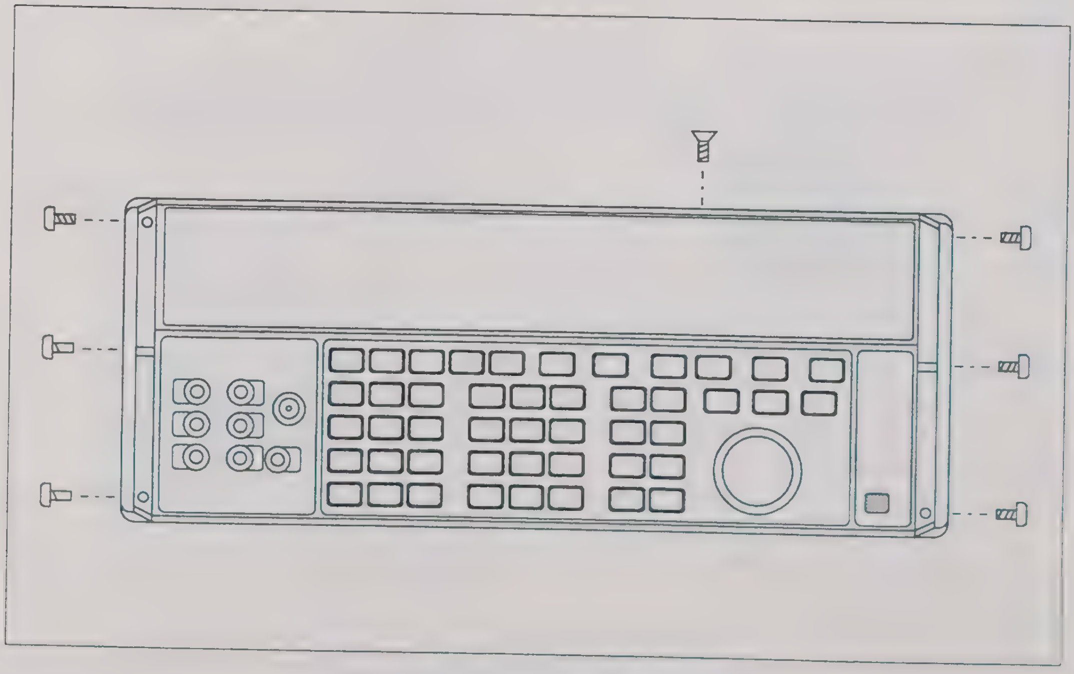


Figure 4-4. Front Panel Removal

DISPLAY ASSEMBLY REMOVAL AND INSTALLATION 4-12.

Once the Front Panel has been removed, use the following procedure to access the Display assembly.

1. Remove the ribbon cable connecting the Display assembly to the Motherboard.
2. Remove the six screws securing the Front Panel Display assembly cover shield. Three of these screws are accessed from the inside, and the other three are accessed along the top of the front panel.
3. Remove the seven screws securing the Front Panel Display assembly to the Front Panel. Gently lift the Front Panel Display assembly up, and remove the keyboard ribbon cable. Now remove the Front Panel Display assembly.

Reverse this procedure to install the Front Panel Display assembly.

KEYBOARD ASSEMBLY REMOVAL AND INSTALLATION 4-13.

The following procedure assumes that the Display Assembly Removal procedure has already been completed.

1. Remove all output cable connections (including GROUND-to-metal) from the front panel binding posts. Save all removed hardware.
2. Remove the two hex screws at the front of each handle. Then remove the front handles.
3. Gently release the eight plastic hook catches, and separate the front panel plastic from the sheet metal.
4. Remove the output adjustment knob flywheel by taking out its center screw. Hold the wheel in place by inserting a pencil in one of the flywheel holes and pressing on one of the plastic standoffs.
5. Remove the nine self-tapping screws connecting the Keyboard assembly to the front panel plastic.
6. Remove the Keyboard assembly by gently releasing the seven plastic hook catches. Work from one side of the board to the other. Start at either side by simultaneously releasing a catch and lifting on the board.

Reverse this procedure to install the Keyboard assembly. When reconnecting the wires to the binding posts, be sure to include a washer on each side of the ring terminals. Refer to the nearby decal or see sheet 4 of the Analog Motherboard schematic in Section 8 of this manual for proper connection of the output cable to the front binding posts.

CAUTION

Do not tighten the nuts that hold the wires to the binding posts more than 7 in-lb. Force exceeding 7 in-lb can destroy the binding posts.

Analog Assembly Removal and Installation 4-14.

The analog assemblies are installed in the sequence shown in Figure 4-5. Note that each module cannot be positioned in any other slot and that identifying information on the tab for each module faces forward. In most cases, the component side of each module also faces forward. The component side faces to the rear for three modules: Current/High Resolution Oscillator (A7), Ohms Cal (A9), and High Voltage Control (A14). All modules except the High Voltage Control pull straight up to disengage from the Digital Motherboard. For the High Voltage Control module, two Phillips head captive screws at the outer corners of the High Voltage Transformer must be removed before the module can be removed.

CAUTION

Do not touch any circuit area on an analog assembly. Contamination from skin oil can produce high resistance paths, with resulting leakage currents and possible erroneous readings. Always grasp an analog assembly by its upper corner ears.

Digital Assembly Removal and Installation 4-15.

Remove the CPU Assembly or the Digital Power Supply Assembly by pulling straight up at the top corners of the assembly. In relation to the chassis side, the CPU Assembly components face toward, and the Digital Power Supply Assembly components face away. See Figure 4-5.

Power Transformer Removal and Installation 4-16.

Use the following procedure to remove the Power Transformer assembly:

1. Remove the 5700A Front and Rear Panels.
2. Remove the Digital Power Supply (A19) and CPU (A20) assemblies.
3. Detach the five connectors leading from the Power Transformer assembly to the Digital Motherboard. The three connectors at the rear of the assembly may not be accessible without first removing the rear fan. With the two digital assemblies (A19 and A20) removed, the four Phillips head screws securing this fan can be accessed through holes in the chassis side.

   Note that no two Power Transformer connectors are the same size and that each connector is keyed; re-connection only involves matching appropriate connectors.
4. Working from the bottom of the instrument, remove the Digital Motherboard (A4) assembly.
5. Remove the eleven screws securing the Power Transformer assembly, as follows:
   - Rear Panel: two screws, which were removed along with the Rear Panel.
   - Front Panel: two screws.
   - Top Edge: four screws.
   - Bottom Edge: three screws.
6. Remove the Power Transformer assembly.

To install the Power Transformer assembly, reverse the preceding six steps.

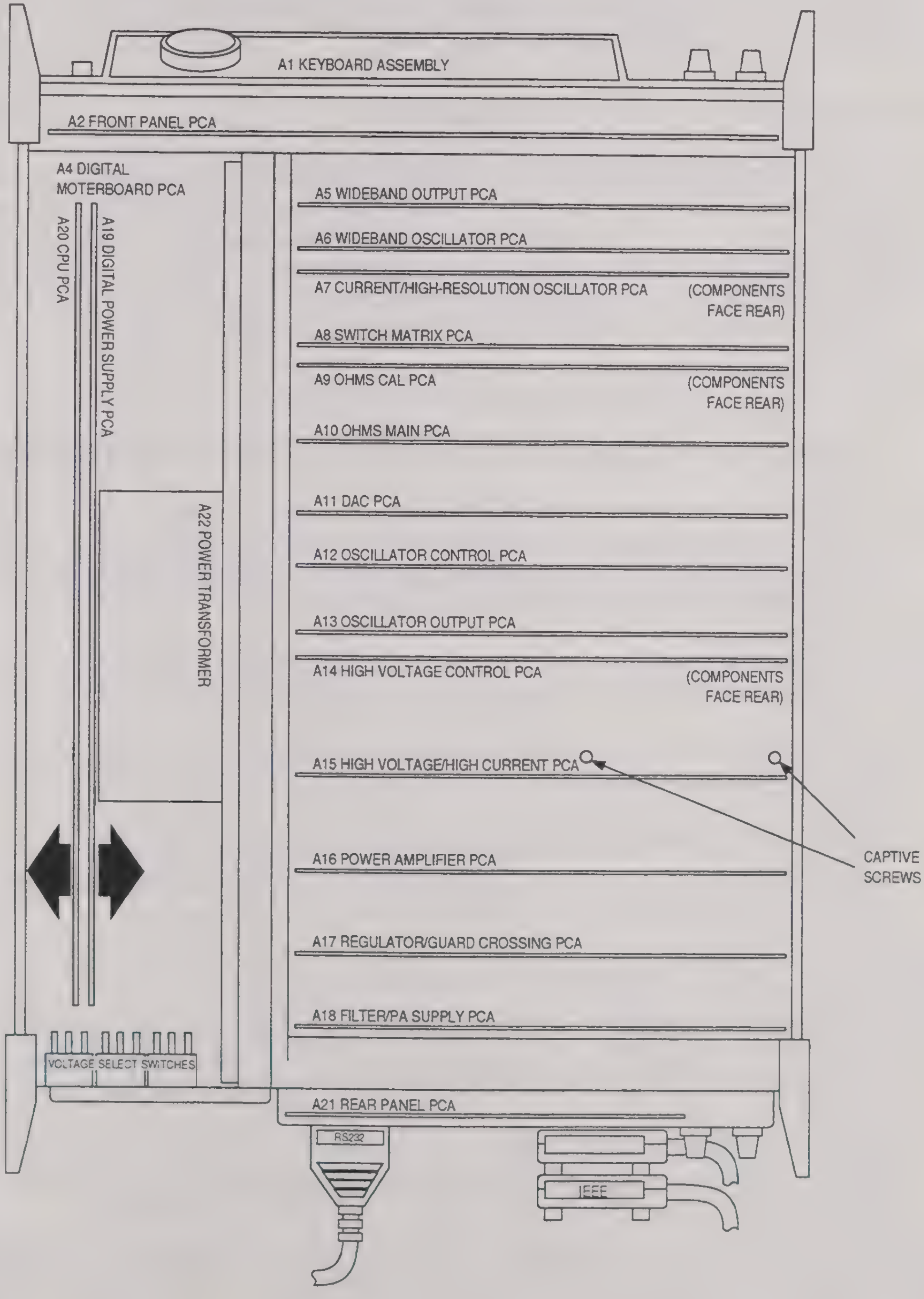


Figure 4-5. Analog and Digital Assemblies

Hybrid Cover Removal 4-17.

When removing the plastic covers from the hybrid assemblies, push the ends of the cover retainer pins through from the back of the circuit board. The retainer pins can be damaged by attempting to pull the covers off.

FRONT/REAR BINDING POST RECONFIGURATION 4-18.

An internal cable can be configured for output connections at either the front or rear binding posts. The front binding posts are usually connected at the factory. If the rear binding posts are connected at the factory, a decal describing this arrangement is attached to the front binding posts. The procedure that follows can be used to swap an existing binding post configuration; it is to be done only at Service Centers. The following procedure can be used to change front-to-rear or rear-to-front.

Reverse this procedure when changing from rear to front output operation.

1. Remove instrument top and bottom covers and remove bottom analog guard cover.
2. Remove the instrument front panel by removing the three hex screws on each front handle side and a single screw on the top of the front panel. See Figure 4-4 for screw locations. By grasping the handles gently pull the front panel away from the frame and lay it on its handles in front of the instrument.
3. Remove all the wires connecting the ring terminals of the output cable to the front panel binding posts. Save all hardware removed during this step.
4. Remove the two screws and restraining board attaching the toroid to the Front Panel. Save these items.
5. Position the output cable and toroid along the bottom left side of the instrument. In a later step, the output cable will be positioned between the Analog Motherboard and the left side panel.
6. Install the Front Panel.
7. Detach the Rear Panel by removing six hex screws (three on each rear handle side) and two screws near the the fan filter on the Rear Panel. See Figure 4-2 for screw locations. Then grasp the handles and gently pull the Rear Panel away from the frame.
8. Orient the instrument so that it is resting on its right side panel, with its bottom facing you.
9. Route the output cable between the left side panel and the Analog Motherboard, ending at the Rear Panel.
10. Using the items obtained during toroid removal, attach the toroid to the two rear panel standoffs.

11. Attach the color-coded output leads to the rear output binding posts. Use one washer on each side of each connecting ring. Verify connections by checking the decal mounted nearby or by matching lead color to the color on the front of the binding post. (Of the eleven wires, four are clear-insulated shield wires. If necessary, refer to page 4 of the Analog Motherboard schematic in Section 8 to determine these connections.)

CAUTION

Do not overtighten hardware on the binding posts. Torque in excess of seven inch-pounds can damage a binding post.

Note that the I GUARD terminal is not connected at the front binding posts; cut away the I GUARD thermal fit covering to connect this terminal at the rear binding posts. Also, the AUX CURRENT ring terminal is not connected at the rear binding posts; this terminal must be insulated and tied off.

12. Replace the rear panel back, the bottom guard cover, and top and bottom covers to complete this procedure.

INSTALLING A WIDEBAND AC MODULE (OPTION -03) 4-19.

CAUTION

THE WIDEBAND OPTION CIRCUIT BOARD ASSEMBLIES CONTAIN STATIC-SENSITIVE COMPONENTS. USE CAUTION TO AVOID STATIC DISCHARGE WHEN HANDLING THE MODULES.

The procedure that follows can be used to install a 5700A-03 Wideband AC Voltage module in a 5700A. The option consists of two circuit board assemblies. This procedure is to be done only at Service Centers.

1. Remove the top and bottom covers and analog section cover. (See ACCESS PROCEDURES this section)
2. Referring to Figure 4-5, locate the slots for the Wideband Output Module (A5) and the Wideband Oscillator Module (A6).
3. Make sure the cable supplied with the Wideband option is connected between the Wideband Output and Wideband Oscillator assemblies.
4. Uncoil the internal wideband output cable one turn from the 5700A chassis and connect it to the coaxial connector on the Wideband Output Module. Make sure the cable is routed in such a way as to avoid shorting to ground when the board is installed in the chassis.
5. Install the Wideband Output and Wideband Oscillator Modules and lock the nylon ears.
6. Run the Wideband Gains Calibration procedure as described in Section 3.
7. Perform the Wideband Flatness Calibration procedure as described in Section 3. The Wideband option is now installed and ready for use.

CLEARING GHOST IMAGES FROM THE CONTROL DISPLAY 4-20.

After prolonged periods of displaying the same message on the Control Display, you may notice a non-uniform brightness of pixels across the display. This phenomenon can be cleared up by lighting up the whole display and leaving it on overnight (or at least several hours). Proceed as follows to burn in the Control Display:

1. Turn on the 5700A and press the “Setup Menus” softkey.
2. Press the “Self Test & Diags” softkey.
3. Press the “5700 Self Diags” softkey.
4. Press the “Front Panel Tests” softkey.
5. Under the “Display” label, press the “Control” softkey.
6. Press the “All On” softkey. This causes all Control Display pixels to light. Press the RESET key or press PREV MENU six times to return to normal operation after an overnight or equivalent burn in period.

REPLACING THE CLOCK/CALENDAR BACKUP BATTERY 4-21.

To replace the lithium button-type battery on the CPU Assembly (A20), proceed as follows:

1. Make sure the power is off and the line power cord disconnected.
2. Follow the access procedures to remove the digital side cover.
3. Remove the CPU Assembly (A20).
4. Desolder and remove battery BT1.
5. Solder a replacement battery in place (refer to the parts list for replacement information if necessary.)
6. Replace the CPU Assembly. After replacing the battery, the setting of the time and date the elapsed time counter (read by the remote query ETIME? and set by ETIME) will need to be reprogrammed.

USING REMOTE COMMANDS RESERVED FOR SERVICING 4-22.

This information documents remote commands not described in the 5700A Operator Manual, Section 5. The commands described here are useful for servicing the instrument.

Using the ETIME Command 4-23.

The ETIME remote command is the companion to ETIME?, the elapsed time query, which is documented in the Operator Manual. The ETIME? query tells you how many minutes the 5700A has been in the power on state since the instrument was built. If you replace the CPU Assembly (A20), the clock/calendar battery (BT1), or the clock/calendar IC (U33), you will lose the setting of ETIME. The ETIME command gives you a way to set this counter to where it was before servicing the instrument. (If possible, read the counter first using ETIME?.) The syntax for this remote command is as follows:

ETIME

Description:

Sets the elapsed time counter to any number of minutes from 0 to 2,147,483,647. The setting of this counter is read by the ETIME? query, described in the 5700A Operator Manual. (Sequential command.)

Parameter:

1. SET_TO
2. Integer, number of minutes

Example:

```
ETIME SET_TO, 4628000
```

Using the FATALITY? AND FATALCLR Commands

The FATALITY? query recovers fault codes that were logged when a fatal problem occurred. These faults are logged into a separate fault queue. Once the faults are read from the queue, you can clear the queue by sending the FATALCLR command. The syntax for these remote commands are as follows:

FATALITY?

Description:

Returns the list of the fatal faults logged since the list was last cleared by the FATALCLR command. (Sequential command.)

Parameter:

None

Response:

(String) The list of faults, one per line in the following format:

<date> <time> <fault code> <fault description string> <EOL>

Example:

```
"8/30/88    6:33:49 Fault
8/30/88     6:34:05 Fault
8/30/88     6:34:12 Fault
8/30/88     6:34:13 Fault
8/30/88     6:34:14 Fault
8/30/88     6:34:15 Fault
8/30/88     6:34:16 Fault
```

FATALCLR?

Description:

Clears the the list of the fatal faults logged since the list was last cleared by the FATALCLR command. The list is read by the FATALITY? query. (Sequential command.)

Parameter:

None

Section 5

Troubleshooting

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INTRODUCTION 5-1.

Information in this section begins with guidance in using self-diagnostics fault codes to isolate a faulty module. The descriptive text helps to quickly locate the source of a fault. Further on, under Component Level Troubleshooting, techniques for isolating faulty components or circuits are described. The Component Level Troubleshooting is only for qualified service personnel who do not wish to replace a faulty module through the Fluke Module Exchange Program. (Refer to Section 1 for module exchange instructions.)

WARNING

TO AVOID ELECTRIC SHOCK, DISCONNECT ALL CABLES FROM THE OUTPUT AND SENSE BINDING POSTS AND DO NOT TOUCH BINDING POST DURING SELF DIAGNOSTICS.

INTERPRETING DIAGNOSTIC FAULT CODES 5-2.

Run self diagnostics by pressing the “Setup Menus” then the “Self Test & Diags” softkey.

NOTE

Self test diagnostics of the analog circuitry are carried out with the 5700A binding posts open circuited. (Cables and test equipment left connected to the binding posts have no effect.)

Test routines connect specific points to the SDL or RCL line and measuring for an expected voltage and tolerance. The SDL and RCL lines are routed to the adc circuit on the DAC assembly for measurement.

Fault code descriptions generally indicate the instrument’s test configuration, point being measured, expected voltage, and probable assembly which is at fault. In some cases, an addition manual measurement may be required to determine the faulty assembly. These manual measurements are noted with the related fault code description. In all cases it is assumed that the Motherboard assemblies are fully operational. Power Supply faults assume that other, non-power supply related assemblies are not loading down the Power Supply.

2700 A7: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Current/Hi Res assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2701 A7: 8255 Port A Fault

The diagnostics software writes and reads data to port A of the 8255 IC on the Current/Hi Res assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2702 A7: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the Current/Hi Res assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2703 A7: 8255 Port C Fault

The diagnostics software reads port C of the 8255 IC on the Current/Hi Res assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2704 Spare

This fault code is not used.

2705 A7: Oven Regulation Fault

The heater voltage of the current hybrid is measured by dividing OVEN TEMP down and connecting it to the SDL line where it is measured by the adc circuit on the DAC assembly to ensure the hybrid is warmed up and regulating. OVEN TEMP should be 0.7V ±10% ±0.2V. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2706 A7: Current Compliance Fault

The Current assembly is configured into each of its ranges in both the dc and ac mode. The output current is connected to the 1.2Ω load resistor. The compliance voltage is determined by measuring the output side of the shunt resistor via the Current/Compliance Voltage Monitor circuit. This fault occurs if the voltage is 10% over the expected. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2707 A7: Hardware Initialization Fault

This fault occurs if the diagnostics software was unable to properly set the Current assembly hardware for diagnostics testing. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2708 Spare

This fault code is not used.

2709 A7: Current Magnitude Fault

The Current assembly is configured into each of its ranges in both the dc and ac mode. The output current is connected to the 1.2Ω load resistor and the current is calculated by measuring the voltage drop across the shunt resistance. This fault occurs if the voltage is 10% over the expected. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2710 A7: Dummy Load Current Fault

The Current assembly is configured into each of its dc ranges. The output current is connected to the 1.2Ω load resistor and the resulting voltage on DUMMY LOAD is connected to the SDL line where it is measured by the adc circuit on the DAC assembly. This fault occurs if the current is over 10% ±5 mA of the output current. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2711 Assembly A7 Is Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Current assembly is not responding. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2712 A7: Hi-Res Clock Fault

The Hi Res clock circuit is checked by connecting HI-RES CLOCK to the SDL line which is measured by the adc circuit on the DAC assembly for 2.5V ±200 mV. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2713 A7: Hi-Res Loop In 100HZ Range

The instrument is set for 2.0V at 100 Hz operation. The input voltage to the VCO circuit is resistively divided to create the control line HI-RES LOOP. HI-RES LOOP is connected to the SDL line where it is measured by the adc circuit on the the DAC assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2714 A7: Hi-Res Loop In 1KHz Range

The instrument is set for 2.0V at 900 Hz operation. The input voltage to the VCO circuit is resistively divided to create the control line HI-RES LOOP. HI-RES LOOP is connected to the SDL line where it is measured by the adc circuit on the the DAC assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2715 A7: Hi-Res Loop In 10KHZ Range

The instrument is set for 2.0V at 11 kHz operation. The input voltage to the VCO circuit is resistively divided to create the control line HI-RES LOOP. HI-RES LOOP is connected to the SDL line where it is measured by the adc circuit on the the DAC assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2716 A7: Hi-Res Loop In 100KHZ Range

The instrument is set for 2.0V at 70 kHz operation. The input voltage to the VCO circuit is resistively divided to create the control line HI-RES LOOP. HI-RES LOOP is connected to the SDL line where it is measured by the adc circuit on the the DAC assembly. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2717 A7: Hi-Res Loop In 1MHZ Range

The instrument is set for 2.0V at 121 kHz, 600 kHz, and 1.19 MHz operation. The input voltage to the VCO circuit is resistively divided to create the control line HI-RES LOOP. HI-RES LOOP is connected to the SDL line where it is measured by the adc circuit on the the DAC assembly at each frequency. This fault occurs if the VCO input voltage is not within 25% ±1.0V of the expected voltage. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2718 Fault In Setting Up AC For Diagnostics

This fault occurs if the diagnostics software was unable to properly set the Hi-Resolution Oscillator hardware for diagnostics testing. A failure indicates the Current/Hi Res assembly (A7) is probably at fault.

2719 A7: 8255 Was Reset

The control word of the 8255 on the Current/Hi Res assembly is determined to be incorrect. A failure indicates the Current/Hi Res assembly is probably at fault.

2800 A11: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the DAC assembly. A failure indicates the DAC assembly (A11) is probably at fault.

2801 A11: 8255 Port A Wires

The diagnostics software writes and reads data to port A of the 8255 IC on the DAC assembly. A failure indicates the DAC assembly (A11) is probably at fault.

2802 A11: 8255 Port B Data Bus

The diagnostics software reads port B of the 8255 IC on the DAC assembly. A failure indicates the DAC assembly (A11) is probably at fault.

2803 A11: 82C54 Status Words

The diagnostics software reads the status of the 82C54 IC on the DAC assembly. A failure indicates the DAC assembly (A11) is probably at fault.

2804 A11: DAC Heaters Not Regulated

The instrument is dormant and the heater voltages (REF HEATER and DCAMP HEATER) to the hybrid assemblies are measured to be 0.7V ±10% ±0.2V. A failure indicates the DAC assembly (A11) is probably at fault.

2805 5700 Not Warmed Up

If a heated hybrid assembly in the instrument is detected to not be in regulation the length of time since the last reset is checked. This fault occurs if the time is less than ten minutes since a reset.

2806 A11: ADC Amp Output Noise

The instrument is dormant. The ± inputs of the DAC adc amplifier circuit are connected to common and the adc then takes ten readings. This failure occurs if the difference between the lowest value and highest value of the ten readings is greater than 500 μV. A failure indicates the DAC assembly (A11) is probably at fault.

2807 A11: ADC Amp Output Offset

The instrument is dormant. The ±inputs of the DACs adc amplifier circuit are connected to common and the adc then takes ten readings. This failure occurs if the average of the ten readings is greater than 3 mV. A failure indicates the DAC assembly (A11) is probably at fault.

2808 A11: ADC Amp Gain Error

The DAC is set to 0.1V on the 11V range and connected to the +input of the DACs adc amplifier circuit and the -input is connected to common. The adc amplifier has a nominal gain of 11 resulting in 1.1V at the adc amplifier output. This gain is checked to be 11 ±5%. A failure indicates the DAC assembly (A11) is probably at fault.

2809 A11: DAC Monitoring Fault

The DAC is set to 1.0V and routed to the adc circuit via DAC HI DIAG. This 1V from the DAC is divided by R70 and R84 on the DAC before going to the adc circuit where it is measured. The DAC is then set to 10V and another reading is taken by the adc. The exact gain of the divider resistors can now be determined by the formula:

Gain = (10-1V) / (adc10-adc1)

A failure occurs if the detected gain is not within 10% of the nominal 22.13. A failure indicates the DAC assembly (A11) is probably at fault.

2810 A11: +11V DC Range Fault

The instrument is configured in the +11V dc range. The DAC is sequentially set to 0V, 1V, and 10V. The DAC output is measure at each setting to be within 7% ±10 mV via DAC HI DIAG by the adc circuit. A failure indicates the DAC assembly (A11) is probably at fault.

2811 A11: -11V DC Range Fault

The instrument is configured in the -11V dc range. The DAC is sequentially set to 0V, -1V, and -10V. The DAC output is measure at each setting to be within 7% ±10 mV via DAC HI DIAG by the adc circuit. A failure indicates the DAC assembly (A11) is probably at fault.

2812 A11: +22V DC Range Fault

The instrument is configured in the +22V dc range. The DAC is sequentially set to 0V, 2V, and 21.9V. The DAC output is measure at each setting to be within 7.2% ±10 mV via DAC HI DIAG by the adc circuit. A failure indicates the DAC assembly (A11) is probably at fault.

2813 A11: -22V DC Range Fault

The instrument is configured in the -22V dc range. The DAC is sequentially set to 0V, -2V, and -21.9V. The DAC output is measure at each setting to be within 7.2% ±10 mV via DAC HI DIAG by the adc circuit. A failure indicates the DAC assembly (A11) is probably at fault.

2814 A11: 6.5V Buffered Reference Fault

The DAC's 6.5V buffered reference (BRF6 and BSRF6) is connected to the -input of the adc circuit and the DAC output (DAC SENSE CAL) is connected to the +input. The 6.5V buffered reference is measure by adjusting the DAC until a null is achieved. This fault occurs if the 6.5V buffered reference is over 10% of the nominal. A failure indicates the DAC assembly (A11) is probably at fault.

2815 A11: 6.5V Reference Fault

The DAC's 6.5V reference (REF6) is connected to the -input of the adc circuit and the DAC output (DAC SENSE CAL) is connected to the +input. The 6.5V reference is measure by adjusting the DAC until a null is achieved. This fault occurs if the 6.5V reference is over 10% of the nominal. A failure indicates the DAC assembly (A11) is probably at fault.

2816 A11: 13V Buffered Reference Fault

The DAC's 13V buffered reference (BRF13 and BSRF13) is connected to the -input of the adc circuit and the DAC output (DAC SENSE CAL) is connected to the +input. The 13V buffered reference is measure by adjusting the DAC until a null is achieved. This fault occurs if the 13V buffered reference is over 10% of the nominal. A failure indicates the DAC assembly (A11) is probably at fault.

2817 A11: 13V Reference Fault

The DAC's 13V reference (REF13) is connected to the -input of the adc circuit and the DAC output (DAC SENSE CAL) is connected to the +input. The 13V reference is measure by adjusting the DAC until a null is achieved. This fault occurs if the 13V reference is over 10% of the nominal. A failure indicates the DAC assembly (A11) is probably at fault.

2818 Assembly A11 Missing

At power up the instrument checks to see what assemblies are not installed. This test verifies that the DAC assembly is not responding. A failure indicates the DAC assembly (A11) is probably at fault.

2819 A11: 8255 Was Reset

The control word of the 8255 on the DAC assembly is read. A failure indicates the DAC assembly (A11) is probably at fault.

2820 A11: Fine Adjust Channel Fault

The second channel of the DAC assembly is tested. The second channel is set to a count which gives 0V at the DAC output. The output is measured by the adc circuit. The second channel count is increased and the increase in the DAC output is verified. A failure indicates the DAC assembly (A11) is probably at fault.

2821 A8/A11: +11/22V DC Zero Estimate Fault

The DAC is in either the +11V or +22V range. Its output (DAC SENSE CAL) is connected to the +input of the adc circuit and the -input of the adc circuit is connected to RCOM. The zero is estimated by adjusting the DAC until a null is achieved. This fault occurs when the nulling process does not converge. A failure indicates the DAC assembly (A11) is probably at fault.

2822 A8/A11: -11/22V DC Zero Estimate Fault

The DAC is in either the -11V or -22V range. Its output (DAC SENSE CAL) is connected to the +input of the adc circuit and the -input is connected to RCOM. The zero is estimated by adjusting the DAC until a null is achieved. This fault occurs when the nulling process does not converge. A failure indicates the DAC (A11) assembly is probably at fault.

2823 A11: Couldn't Estimate +11V Or 22V Gain

One of the DAC's references is connected to the -input of the adc circuit and DAC output (DAC SENSE CAL) is connected to the +input. The gain is estimated by adjusting the DAC until a null is achieved. This fault occurs when the nulling process does not converge. A failure indicates the DAC (A11) assembly is probably at fault.

2824 A11: Couldn't Estimate 6.5V Or 13V Ref

One of the DAC's references is connected to the -input of the adc circuit and DAC output (DAC SENSE CAL) is connected to the +input. The reference is estimated by adjusting the DAC until a null is achieved. This fault occurs when the nulling process does not converge. A failure indicates the DAC assembly (A11) is probably at fault.

2825 A11: Couldn't Est 6.5V Or 13V Buf Ref

One of the DAC's buffered references is connected to the -input of the adc circuit and DAC output (DAC SENSE CAL) is connected to the +input. The buffered reference is estimated by adjusting the DAC until a null is achieved. This fault occurs when the nulling process does not converge. A failure indicates the DAC (A11) assembly is probably at fault.

2826 A11: A/D Overload Fault

The adc on the DAC assembly is tested by putting a positive overload then a negative overload into the adc input. The adc output is read and compared against an expected overload reading for both the positive and negative overload. If either of these tests fail the fault message is sent. A failure on either of these tests indicates that the DAC assembly (A11) is at fault.

3100 A14: 8255 Control Word

The diagnostics software read the control word of the 8255 IC on the High Voltage Control assembly. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3101 A14: 8255 Port A Fault

The diagnostics software writes and reads data to port A of the 8255 IC on the High Voltage Control assembly. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3102 A14: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the High Voltage Control assembly. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3103 A14: 8255 Port C Fault

The diagnostics software reads port C of the 8255 IC on the High Voltage Control assembly. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3104 A15: HV Oven Regulation Fault

The heater voltage of the High Voltage/High Current assembly HR7 hybrid is divided by 11 and is measured by the adc circuit. The heater voltage should be 0.7V ±10% ±0.2V. If it is out of tolerance, the High Voltage/High Current assembly (A15) is probably at fault.

3105 A15: HV I Oven Regulation Fault

The heater voltage of the High Voltage/High Current assembly H4 hybrid is routed to the High Voltage Control assembly via HV MUX0. The High Voltage Control connects HV MUX0 to the SDL which is routed to the DAC assembly where it is measured by the adc circuit to be 0.7V ±10% ±0.2V. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3106 A15: DC HV Amp Noise Fault

The High Voltage assemblies are configured in the dormant state with the exception that the DAC output, set to 0.0V, is connected to the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly. This circuit is configured as an amplifier with a gain of 100 whose output is connected to the RCL line. The RCL line is routed to the DAC assembly where it is measured by the adc circuit. The adc circuit takes ten readings and this failure occurs if the difference between the lowest value and highest value of the ten readings is over 0.001V. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3107 A15: DC HV Amp Offset Fault

The High Voltage assemblies are configured in the dormant state with the exception that the DAC output, set to 0.0V, is connected to the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly. This circuit is configured as an amplifier with a gain of 100 whose output is connected to the RCL line. The RCL line is routed to the DAC assembly where it is measured by the adc circuit. The adc circuit takes ten readings and this failure occurs if the average value is over 0.003V. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3108 A15: DC HV Amp Gain Fault

The High Voltage assemblies are configured in the dormant state with the exception that the DAC output, set to -0.001V, is connected to the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly. This circuit is configured as an amplifier with a gain of -100 resulting in 0.1V at the output which is connected to the RCL line. The RCL line is routed to the DAC assembly where it is measured by the adc circuit. The gain of this circuit is determined by this reading along with the previously checked offset. This failure occurs if the determined gain is over 6% of the nominal -100. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3109 A15: HV +DC Preamplifier Fault

The instrument is set to the dc 1100V range with the amplitude set to 220V, 600V, and 1100V. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.55V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3110 A15: HV +DC Series Pass & Current Fault

The instrument is set to the dc 1100V range with the amplitude set to 220V, 600V, and 1100V. HV MUX3 from the HV DC OUTPUT SERIES PASS & CURRENT LIMIT circuit on the High Voltage/High Current assembly is measured for -0.035V ±0.02V. HV MUX3 is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3111 A15: HV +DC High Voltage Output Fault

The instrument is set to the dc 1100V range with the amplitude set to 220V, 600V, and 1100V. This output voltage is divided to create MUX5 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This failure occurs if the expected output voltage is not within 12% of the nominal.

3112 A15: HV +DC Ref/Error Amplitude Fault

The instrument is set to the dc 1100V range with the amplitude set to 220V, 600V, and 1100V. The control signal AMPLITUDE from the Magnitude Control circuitry of the High Voltage Control assembly is measured. The nominal gain from AMPLITUDE to HV OUT is 135. This gain is checked by measuring AMPLITUDE to be 0.0074 of the nominal output ±25%. AMPLITUDE is divided to create MUX7 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3113 A15: HV -DC Preamplifier Fault

The instrument is set to the dc 1100V range with the amplitude set to -220V, -600V, and -1100V. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 2.3V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3114 A15: HV -DC Series Pass & Current Fault

The instrument is set to the dc 1100V range with the amplitude set to -220V, -600V, and -1100V. HV MUX3 from the HV DC OUTPUT SERIES PASS & CURRENT LIMIT circuit on the High Voltage/High Current assembly is measured for -0.035V ±0.02V. HV MUX3 is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3115 A15: HV -DC High Voltage Output Fault

The instrument is set to the dc 1100V range with the amplitude set to -220V, -600V, and -1100V. This output voltage is divided to create MUX5 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This failure occurs if the expected output voltage is not within 12% of the nominal.

3116 A15: HV -DC Reference/Error Amp Fault

The instrument is set to the dc 1100V range with the amplitude set to -220V, -600V, and -1100V. The control signal AMPLITUDE from the Magnitude Control circuitry of the High Voltage Control assembly is measured. The nominal gain from AMPLITUDE to HV OUT is 135. This gain is checked by measuring AMPLITUDE to be 0.0074 of the nominal output ±25%. AMPLITUDE is divided to create MUX7 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3117 A14/A15: HV +DC Current Error Amp Fault

The 5700A is set to the dc +2.2A current range with the amplitude set to +0.22A, +0.6A, and +1.2A. The control signal AMPLITUDE from the magnitude control circuitry of the High Voltage Control assembly is measured to be within 25% of the expected value. AMPLITUDE is divided to create MUX7 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3118 A14/A15: HV -DC Current Error Amp Fault

The 5700A is set to the dc -2.2A current range with the amplitude set to -1.2A. The control signal AMPLITUDE from the magnitude control circuitry of the High Voltage Control assembly is measured to be within 25% of the expected value. AMPLITUDE is divided to create MUX7 which is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3119 A14/A15: HV +DC Current Abs. Value

The instrument is configured to the +DC 2.2A range and set for an output of 0.22A, 0.60A, and 1.2A. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The Current control signal G OUT from the High Voltage/High Current assembly is routed to the Absolute Value Circuit on the High Voltage Control. The output from the Absolute Value circuit should be = 2.17 * I, ±25%, where “I” is the output current. This voltage is divided creating MUX6 which is connected to the SDL line where it is measured by the adc circuit on the DAC assembly.

3120 A14/A15: HV -DC Current Abs. Value

The instrument is configured to the -DC 2.2A range and set for an output of -1.2A. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The Current control signal G OUT from the High Voltage/High Current assembly is routed to the Absolute Value Circuit on the High Voltage Control. The output from the Absolute Value circuit is a positive voltage which should be = 2.17 * I, ±25%, where “I” is the output current. This voltage is divided creating MUX6 which is connected to the SDL line where it is measured by the adc circuit on the DAC assembly.

3121 Spare

This fault code is not used.

3122 A14/A15: HV AC 1KHZ, Preamp (lo)

The instrument is configured to the ac 1100V range with on amplitude of 220V at 1 kHz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3123 A14/A15: HV AC 1KHZ, Preamp (mid)

The instrument is configured to the ac 1100V range with on amplitude of 600V at 1 kHz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3124 A14/A15: HV AC 1KHZ, Preamp (hi)

The instrument is configured to the ac 1100V range with on amplitude of 1100V at 1 kHz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3125 A14/A15: HV AC 100HZ, Preamp (lo)

The instrument is configured to the ac 1100V range with on amplitude of 220V at 50 Hz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3126 A14/A15: HV AC 100HZ, Preamp Fault

The instrument is configured to the ac 1100V range with on amplitude of 600V at 50 Hz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3127 A14/A15: HV AC 100HZ, Preamp (hi)

The instrument is configured to the ac 1100V range with on amplitude of 1100V at 50 Hz. The output of the DC HV AMPLIFIER/AC SENSE BUFFER circuit of the High Voltage/High Current assembly is measured for 0.0V ±0.2V. This voltage is divided to create HV MUX2 which is routed to Diagnostic circuit on the High Voltage Control assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly.

3128 A14/A15: HV AC 1KHZ, Output (lo)

The instrument is configured to the ac 1100V range with on amplitude of 220V at 1 kHz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 220V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3129 A14/A15: HV AC 1KHZ, Output (mid)

The instrument is configured to the ac 1100V range with on amplitude of 600V at 1 kHz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 600V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3130 A14/A15: HV AC 1KHZ, Output (hi)

The instrument is configured to the ac 1100V range with on amplitude of 1100V at 1 kHz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 1100V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3131 A14/A15: HV AC 100HZ, Output (lo)

The instrument is configured to the ac 1100V range with on amplitude of 220V at 50 Hz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 220V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3132 A14/A15: HV AC 100HZ, Output (mid)

The instrument is configured to the ac 1100V range with on amplitude of 600V at 50 Hz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 600V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3133 A14/A15: HV AC 100HZ, Output (hi)

The instrument is configured to the ac 1100V range with on amplitude of 1100V at 50 Hz. The high voltage output is divided and converted to a dc voltage by the OUTPUT PEAK MEASURE circuit to create MUX5. This dc voltage is equal to the positive peaks of the ac amplitude. MUX5 is connected to the SDL line for measurement by the adc circuit on the DAC assembly. The high voltage output is measured for 1100V ±12%. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3134 Spare

This fault code is not used.

3135 Assembly A14 Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the High Voltage Control assembly is not responding. A failure indicates the High Voltage Control assembly is probably at fault.

3136 A14: 8255 Was Reset

The control word for the 8255 on the High Voltage Control assembly is read. A failure indicates the High Voltage Control assembly (A14) is probably at fault.

3137 A14/A15/A16: 2.2A AC Range Mag. Fault

The instrument is configured to the ac 2.2A range and set to 0.22A at 1 kHz, 0.6A at 1 kHz, 1.1A at 1 kHz, 0.6A at 40 Hz, and 1.1A at 50 Hz. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The input current from the Current assembly is is measured at each setting by measuring the voltage drop across the 22 mA range shunt resistor on the Current assembly. This voltage drop is measured to be within 10% ±20 μV of the nominal. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3138 A14/A15/A16: 2.2A AC Range Compliance

The instrument is configured to the ac 2.2A range and set to 0.22A at 1 kHz, 0.6A at 1 kHz, 1.1A at 1 kHz, 0.6A at 40 Hz, and 1.1A at 50 Hz. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The compliance voltage is determined by measuring the output side of the 22 mA range shunt resistor on the Current assembly. This is done via the Current Compliance Monitor circuit on the Current assembly and is checked to be less than 10V. A failure indicates the High Voltage/High Current assembly is probably at fault.

3139 A14/A15/A16: 2.2A AC Range Amplitude

The instrument is configured to the ac 2.2A range and set for an output current of 0.22A at 1 kHz, 0.6A at 1 kHz, 1.1A at 1 kHz, 0.6A at 40 Hz, and 1.1A at 50 Hz. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The Current control signal G OUT from the High Voltage/High Current assembly is routed to the Magnitude Control circuit of the High Voltage Control assembly. The control signal AMPLITUDE is measured to be = I * 4.23 + 4.447, ±20%. This voltage is divided creating MUX7 which is connected to the SDL line where it is measured by the adc circuit on the DAC assembly.

3140 A14/A15/A16: 2.2A AC Range Abs. Value

The instrument is configured to the ac 2.2A range and set for an output current of 0.22A at 1 kHz, 0.6A at 1 kHz, 1.1A at 1 kHz, 0.6A at 40 Hz, and 1.1A at 50 Hz. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The Current control signal G OUT from the High Voltage/High Current assembly is routed to the Absolute Value Circuit on the High Voltage Control. The output from the Absolute Value circuit is a positive voltage which should be = 3.07 * I, ±10%, where "I" is the output current. This voltage is divided creating MUX6 which is connected to the SDL line where it is measured by the adc circuit on the DAC assembly.

3141 A14/A15/A16: 2.2A DC Range Dummy Load

The instrument is configured to the dc 2.2A range. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The resulting voltage across this load resistor is measured by connected DUMMY LOAD on the Current assembly to the SDL line where it is measured by the adc circuit on the DAC assembly. This fault occurs if the determined current is over 10% ±5 mA of the nominal. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3142 A14/A15/A16: 2.2A DC Range Compliance

The instrument is configured to the dc 2.2A range. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The compliance voltage is determined by measuring the output side of the 22 mA range shunt resistor on the Current assembly. This is done via the Current Compliance Monitor circuit on the Current assembly and is checked to be less than 10V. A failure indicates the High Voltage/High Current assembly is probably at fault.

3143 A14/A15/A16: 2.2A DC Range Magnitude

The instrument is configured to the dc 2.2A range. The output current from the High Voltage/High Current assembly is routed to the Current assembly where it is connected to the 1.2Ω load resistor. The output current is calculated by measuring the voltage drop across the 22 mA range shunt resistor on the Current assembly. This fault occurs if the determined current is over 10% of the nominal. A failure indicates the High Voltage/High Current assembly (A15) is probably at fault.

3300 A9: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Ohms Cal assembly (A9). A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3301 A9: 8255 Port A Fault

The diagnostics software writes and reads data to port A of the 8255 IC on the Ohms Cal assembly (A9). A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3302 A9: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the Ohms Cal assembly (A9) during the instruments dormant state. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3303 A9: 8255 Port C Fault

The diagnostics software reads port C of the 8255 IC on the Ohms Cal assembly (A9) during the instruments dormant state. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3304 A9: 10V Source Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is set for 10V and routed to the adc circuit on the DAC assembly, via the SDL line, where it is measured for 10V ±7%. This 10V can be verified with a DMM, hi to TP13 and low to TP12. If the measured voltage is out of tolerance, the 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is faulty. If the measured voltage is within tolerance, the diagnostic circuit on the Ohms Cal assembly (A9) is probably at fault.

NOTE

If extender cards are available, verify that 10V SENSE LO is tied to SCOM. This connection is done with relays on both the Ohms assemblies.

3305 A9: 5V Source Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is set for 5V and routed to the adc circuit on the DAC assembly, via the SDL line, where it is measured for 5V ±7%. A failure indicates the 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is probably at fault.

NOTE

If extender cards are available verify that 10V SENSE LO is tied to SCOM. This connection is done with relays on both the Ohms assemblies.

3306 A9: 2V Source Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is set for 2V and routed to the adc circuit on the DAC assembly, via the SDL line, where it is measured for 2V ±7%. A failure indicates the 2/5/10V SOURCE circuit on the Ohms Cal assembly (A9) is probably at fault.

NOTE

If extender cards are available verify that 10V SENSE LO is tied to SCOM. This connection is done with relays on both the Ohms assemblies.

3307 Spare

This fault code is not used.

3308 A9: Diff Amp Offset Fault

The offset of the Differential Amplifier circuit on the Ohms Cal assembly (A9) is checked. The DAC output is set to 0V and connected to both the ±inputs of the Differential Amplifier circuit. The output is routed to the adc circuit on the DAC assembly via the RCL line. Ten reading are taken and this fault occurs of the difference between the lowest and highest value if over 1 mV or if the absolute value is over 10 mV. A failure indicates the Differential Amplifier circuit on the Ohms Cal assembly (A9) is probably at fault.

3309 A9: Diff Amp Gain Fault

The gain (nominal gain of 75) Differential Amplifier circuits on the Ohms Cal assembly (A) is checked. The DAC output is set to 86.7 mV and connected to the -input of the Diff Amp circuit with the +input connected to RCOM. The output of the Diff Amp circuit is routed to the adc circuit on the DAC assembly, via the RCL line, where it is compared to the 6.5V reference. This fault occurs if the determined gain is over 6% from the nominal 75. A failure indicates the Differential Amplifier circuit on the Ohms Cal assembly (A9) is probably at fault.

3310 A9: Diff Amp Noise Fault

The noise of the differential amplifier circuit on the Ohms Cal assembly (A9) is checked. The DAC output is set to 0V and connected to both the ±inputs of the differential amplifier circuit. The output is routed to the adc circuit on the DAC assembly via the RCL line. Ten readings are taken and this fault occurs if the difference between the lowest and highest value if over 1 mV. A failure indicates the differential amplifier circuit on the Ohms Cal assembly (A9) is probably at fault.

3311 A9/A10: Ohms 10:1 Divider Fault

The 2/5/10V SOURCE circuit is set for 10V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly (A9). The resulting 1V across the 10 kΩ portion is measure for 1V ±3% ±15 mV. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3312 A9/A10: Ohms 1:1 Divider Fault

The 2/5/10V SOURCE circuit is set for 10V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly (A9). This arrangement is measured for 10V ±3% ±15 mV. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3313 A9/A10: 10 Kilohm Diagnostic Fault

The 2/5/10V SOURCE circuit is set for 10V and connected across the 20 kΩ resistance made from the 10 kΩ in Z5 on the Ohms Cal assembly, (A9) and the 10 kΩ string on the Ohms Main assembly (A10) connected in series. The resulting 5V across the 10 kΩ string on the Ohms Main assembly is measured for 5V ±3% ±15 mV. Measure the 5V across the 10 kΩ string by connecting a DMM hi to TP2 and low to TP1 on the Ohms Cal assembly (A9). If this voltage is greater than 5V the Ohms Main assembly (A10) is probably at fault. If the voltage is less than or equal to 5V the Ohms Cal assembly (A9) is probably at fault.

3314 A9/A10: 19 Kilohm Cal Diag Fault

The 2/5/10V SOURCE circuit is set for 10V and connected across the 29 kΩ resistance made from the 10 kΩ in Z5 on the Ohms Cal assembly, (A9) and the 19 kΩ string on the Ohms Main assembly (A10) connected in series. The resulting 6.55V across the 19kΩ string on the Ohms Main assembly is measured for 6.55V ±3% ±15 mV. A failure indicates the Ohms Main assembly (A10) is probably at fault.

3315 A9/A10: 10 Ohm Cal Diag Fault

The 2/5/10V SOURCE circuit is set for 2V and connected across the 100Ω string on the Ohms Main assembly. The resulting 0.2 V across the 10Ω portion is connected to the -input of the Differential Amplifier on the Ohms Cal assembly. The output of the DAC assembly is set to 2V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly. The resulting 0.2V across the 10 kΩ portion of Z5 is connected to the +input of the Differential Amplifier. The output of the Differential Amplifier is routed to the adc circuit on the DAC assembly, via the RCL line, and measured for 0V ±3% ±15 mV. Verify that the divided DAC voltage of 0.2V ±5% is at the +input of the Diff Amp by connecting DMM hi to TP20 and low to TP10 of the Ohms Cal assembly. If this measured voltage is out of tolerance, the Ohms Cal assembly (A9) is probably at fault.

3316 A9/A10: 19 Ohm Cal Diag Fault

The 2/5/10V SOURCE circuit is set for 2V and connected across the 190Ω string on the Ohms Main assembly. The resulting 0.2V across the 10Ω portion is connected to the -input of the Differential Amplifier on the Ohms Cal assembly. The output of the DAC assembly is set to 2V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly. The resulting 0.2V across the 10 kΩ portion of Z5 is connected to the +input of the Differential Amplifier. The output of the Differential Amplifier is routed to the adc circuit on the DAC assembly, via the RCL line, and measured for 0V ±3% ±15 mV. A failure indicates the calibration of the 19Ω resistance on the Ohms Main assembly (A10) is probably at fault.

3317 A9/A10: 100 Kilohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 100 kΩ string. The resulting 1V across the 10 kΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3318 A9/A10: 190 Kilohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 190 kΩ string. The resulting 1V across the 19 kΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3319 A9/A10: 1M Ohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 1 MΩ string. The resulting 1V across the 100 kΩ portion is measured for 1V ±3% ±15 mV. Measure the 1 volt across the 100 kΩ string by connecting a DMM hi to TP14 and low to TP2 of the Ohms Cal assembly (A9). If the voltage is out of tolerance, the Ohms Main assembly (A10) is probably at fault. If the voltage is within tolerance, the Ohms Cal assembly (A9) if probably at fault.

3320 A9/A10: 1.9M Ohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 1.9 MΩ string. The resulting 1V across the 190 kΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3321 A9/A10: 10M Ohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 10 MΩ string. The resulting 1V across the 1 MΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3322 A9/A10: 19M Ohm Ratio 1

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 19 MΩ string. The resulting 1V across the 1.9 MΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3323 A9/A10: 19M Ohm Ratio 2

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 19 MΩ string. This 10V across the 19 MΩ portion is measured for 10V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3324 A9/A10: 100M Ohm Ratio Fault

The 2/5/10V SOURCE circuit on the Ohms Cal assembly is set to 10V which is routed to the Ohms Main assembly and connected to the 10 MΩ string. The resulting 1V across the 1 MΩ portion is measured for 1V ±3% ±15 mV. A failure indicated the Ohms Main assembly (A10) is probably at fault.

3325 A9/A10: 10 Kilohm Check Fault

The Current assembly (A7) outputs 0.13 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 10 kΩ string. The voltage drop across the 10 kΩ string is measured for 1.3V ±3% ±15 mV. Measure this voltage drop by connecting the DMM hi to TP5 and the low to TP6 of the Ohms Cal assembly (A9). If the voltage is out of tolerance, the Ohms Main assembly is probably at fault. If the voltage is within tolerance, the Ohms Cal assembly is probably at fault.

3326 A9/A10: 19 Kilohm Check Fault

The Current assembly (A7) outputs 0.13 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 19 kΩ string. The voltage drop across the 19 kΩ string is measured for 2.47V ±3% ±15 mV. A failure indicates the Ohms Main assembly is probably at fault.

3327 A9/A10: 1 Kilohm Check Fault

The Current assembly (A7) outputs 1.3 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 1 kΩ string. The voltage drop across the 1 kΩ string is measured for 1.3V ±3% ±15 mV. A failure indicates the Ohms Main assembly is probably at fault.

3328 A9/A10: 1.9 Kilohm Check Fault

The Current assembly (A7) outputs 1.3 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 1.9 kΩ string. The voltage drop across the 1.9 kΩ string is measured for 2.47V ±3% ±15 mV. A failure indicates the Ohms Main assembly (A10) is probably at fault.

3329 A9/A10: 100 Ohm Check Fault

The Current assembly (A7) outputs 13 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 100Ω string. The voltage drop across the 100Ω string is measured for 1.3V ±3% ±15 mV. A failure indicates the Ohms Main assembly is probably at fault.

3330 A9/A10: 190 Ohm Check Fault

The Current assembly (A7) outputs 13 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 190Ω string. The voltage drop across the 190Ω string is measured for 2.47V ±3% ±15mV. A failure indicates the Ohms Main assembly (A10) is probably at fault.

3331 A9/A10: 10 Ohm Check Fault

The Current assembly (A7) outputs 130 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 10 Ohm resistance. The voltage drop across the 10Ω resistance is measured for 1.3V ±3% ±15 mV. A failure indicates the Ohms Main assembly is probably at fault.

3332 A9/A10: 19 Ohm Check Fault

The Current assembly (A7) outputs 130 mA which is routed to the Ohms Main assembly (A10), via INT OUT HI, where it is connected to the 19Ω resistance. The voltage drop across the 19Ω string is measured for 2.47V ±3% ±15 mV. A failure indicates the Ohms Main assembly is probably at fault.

3333 A9/A10: 1 Ohm Check Fault

The Current assembly (A7) outputs 130 mA which is routed through the Ohms Main assembly (A10), via INT OUT HI, to the Ohms Cal assembly (A9) where it is connected to the 1Ω resistance. The voltage drop across the 1Ω resistance is measured for 0.13V ±3% ±15 mV. A failure indicates the Ohms Cal assembly is probably at fault.

3334 A9/A10: 1.9 Ohm Check Fault

The Current assembly (A7) outputs 13 mA which is routed through the Ohms Main assembly (A10), via INT OUT HI, to the Ohms Cal assembly (A9) where it is connected to the 1.9Ω resistance. The voltage drop across the 1.9Ω resistance is measured for 24.7 mV ±3% ±15 mV. A failure indicates the Ohms Cal assembly is probably at fault.

3335 A9/A10: Ohms Short Check Fault

The Current assembly (A7) outputs 130 mA which is routed through the Ohms Main assembly (A10), via INT OUT HI, to the Ohms Cal assembly (A9) where it is connected to the short. The voltage drop across the short is measured for 0V ±3% ±15 mV. A failure indicates the Ohms Cal assembly is probably at fault.

3336 A9/A10: 2 Wire Compensation Fault

The two-wire compensation circuit is tested at its limits. The tests check to see if the circuit can compensate for lead drops for the following currents and loads:

- 10 mA into 10Ω
- -10 mA into 10Ω
- 10 µA into 10 kΩ
- 5.6 µA into 19 kΩ

The Current assembly (A7) generates the desired current which is routed through the Ohms Main assembly (A10), via INT OUT HI, to the Ohms Cal assembly (A9) where it is connected to ACOM. The current into ACOM causes the 2 Wire Lead Drop Compensation circuit to generate a voltage which is used in creating an equal current in the opposite polarity for the current in ACOM. The voltage is measured on the DAC assembly via the SDL line. The voltage expected from the compensation circuit is V = I * -1000V/A. Failure of any of the tests indicates that the 2 Wire Lead Drop Compensation circuit on the Ohms Cal assembly (A9) is probably at fault.

3337 A9/A10: Ohms Correction Factor Fault

The 13 volt reference on the DAC assembly is checked by the adc circuit on the DAC assembly. A failure indicates the DAC assembly (A11) is probably at fault.

3338 Assembly A9 Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Ohms Cal assembly is not responding. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3339 A9: 8255 Was Reset

The control word of the 8255 on the Ohms Cal assembly is read. A failure indicates the Ohms Cal assembly (A9) is probably at fault.

3340 A9/A10: 100 Ohm Cal Diag Fault

The 2/5/10V SOURCE circuit is set for 2V and connected across the 1 kΩ string on the Ohms Main assembly. The resulting 0.2V across the 100Ω portion is connected to the -input of the differential amplifier on the Ohms Cal assembly. The output of the DAC assembly is set to 2V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly. The resulting 0.2V across the 10 kΩ portion of Z5 is connected to the +input of the differential amplifier. The output of the differential amplifier is routed to the adc circuit on the DAC assembly, via the RCL line, and measured for 0V ±3% ±15 mV. A failure indicates the calibration of the 100Ω resistance on the Ohms Main assembly (A10) is probably at fault.

3341 A9/A10: 190 Ohm Cal Diag Fault

The 2/5/10V SOURCE circuit is set for 2V and connected across the 1.9 kΩ string on the Ohms Main assembly. The resulting 0.2V across the 190Ω portion is connected to the -input of the Differential Amplifier on the Ohms Cal assembly. The output of the DAC assembly is set to 2V and connected across the 100 kΩ resistance in Z5 on the Ohms Cal assembly. The resulting 0.2V across the 10 kΩ portion of Z5 is connected to the +input of the differential amplifier. The output of the differential amplifier is routed to the adc circuit on the DAC assembly, via the RCL line, and measured for 0V ±3% ±15 mV. A failure indicates the calibration of the 190Ω resistance on the Ohms Main assembly (A10) is probably at fault.

3400 A12: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Oscillator Control assembly. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3401 A12: 8255 Port A

The diagnostics software writes and reads data to port A of the 8255 IC on the Oscillator Control assembly. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3402 A12: 8255 Port B

The diagnostics software reads port B of the 8255 IC on the Oscillator Control assembly during the instruments dormant state. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3403 A12: 8255 Port C

The diagnostics software reads port C of the 8255 IC on the Oscillator Control assembly during the instruments dormant state. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3404 A13: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Oscillator Output assembly. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3405 A13: 8255 Port A

The diagnostics software writes and reads data to port A of the 8255 IC on the Oscillator Output assembly. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3406 A13: 8255 Port B

The diagnostics software reads port B of the 8255 IC on the Oscillator Output assembly during the instruments dormant state. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3407 A13: 8255 Port C

The diagnostics software reads port C of the 8255 IC on the Oscillator Output assembly during the instruments dormant state. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3408 A13: Fixed Ampl. Osc Fault

The instrument is set for 1V ac at 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz. The signal line INTEGRATOR OUT on the Oscillator Output assembly is measured via the SDL line. Each frequency range is tested at the fixed 1V amplitude. INTEGRATOR OUT is measured to be 0V ±1V at the lower three frequency ranges, ±2V at the 100 kHz range, and ±5V at the 1 MHz range. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3409 A13: Phase Lock Loop Fault

The instrument is set for 1V ac at 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz. The signal line LOOP FILTER OUT on the Oscillator Output assembly is measured via the SDL line. Each frequency range is tested at the fixed 1V amplitude. LOOP FILTER OUT is measured to be 0V ±5V. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3410 A12/A13: 22V Amp Bias Adj Error

The instrument is set for 1V and 10V at 1 kHz operation. Signal line AMP1 on the Oscillator Output assembly is measured via the SDL line. A failure indicates that AMP1 was measured to be greater than 500 mV but less than 2V. A failure indicates the Oscillator Output assembly (A13) is probably at fault. Check the zero adjustment of potentiometer R30 on the OSC SMD AMP assembly.

3411 A12/A13: 22V Amp Nonfunctional

The instrument is set for 1V and 10V at 1 kHz operation. Signal line AMP1 on the Oscillator Output assembly is measured via the SDL line. A failure indicates that AMP1 was measured to be greater than 2V. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3412 A12 To A13 Interface Fault

The instrument is set for 1V 1 kHz operation. Signal VREF on the Oscillator Control assembly (A12) is measured via the SDL line to be 3.16V ±100 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3413 A12/A13: 14 bit DAC Nonfunctional

The instrument is set for 1V 1 kHz operation. Signal 14 BIT DAC OUT on the Oscillator Control assembly is measured via the SDL line. The 15 bit DAC circuit on the Oscillator Control assembly is set for outputs of 0V, -1.58V, and -3.16V, and is measured to be within ± 100 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3414 A12/A13: Nonlinear Control Loop 2Vrng

The instrument is set for 1V 1 kHz operation. Signal ERROR INT. OUT on the Oscillator Control assembly is measured via the SDL line to be 0V ±5.0V. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3415 A12/A13: Nonlinear Control Loop 20Vrng

The instrument is set for 10V 1 kHz operation. Signal ERROR INT. OUT on the Oscillator Control assembly is measured via the SDL line to be 0V ±5.0V. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3416 A12/A13: DAC 15th Bit Fault

The instrument is set for 1V 1 kHz operation. Bit 14 of the 15 BIT DAC is checked. A failure indicates the Oscillator Control assembly (A12) is probably at fault. Check FET Q19.

3417 A12: DC Sensor Buffer Fault

The instrument is set for 1V 1 kHz operation. The output of the DC Sense Buffer, on the Oscillator Control assembly, is measured via the RCL line. This measurement is done by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±500 µV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3418 A12: Sensor Loop/Sq. Root Amp Fault

The instrument is set for 2.19V 1 kHz operation. The output of the DC Sense Buffer is connected to the main ac/dc sensor on the Oscillator Control assembly. The output of the main sensor is measured via the RCL line by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±100 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3419 A12: AC Sensor Buff (2V Range)

The instrument is set for 2.19V 1 kHz operation. The output of the AC Sense Buffer is connected to the main ac/dc sensor on the Oscillator Control assembly. The output of the main sensor is measured via the RCL line by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±160 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3420 A12: AC Sensor Buff (20V Range)

The instrument is set for 21.9V 1 kHz operation. The output of the AC Sense Buffer is connected to the main ac/dc sensor on the Oscillator Control assembly. The output of the main sensor is measured via the RCL line by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±160 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3421 A12: AC Cal Sensor (2V Range)

The instrument is set for 2.19V 1 kHz and configured as in the 2V range ac/ac calibration. The output of the ac/ac sensor on the Oscillator Control assembly is measured via the RCL line. The output of this ac/ac sensor is measured by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±100 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3422 A12: AC Cal Sensor (20V Range)

The instrument is set for 21.9V 1 kHz and configured as in the 20V range ac/ac calibration. The output of the ac/ac sensor on the Oscillator Control assembly is measured via the RCL line. The output of this ac/ac sensor is measured by comparing it to the DAC assembly output voltage. The difference is measured to be 0V ±100 mV. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3423 Assembly A12 Missing

At power up the instrument checks to see what assemblies are not installed. This test confirms that the Oscillator Control assembly is not responding. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3424 Assembly A13 Missing

At power up the instrument checks to see what assemblies are not installed. This test confirms that the Oscillator Output assembly is not responding. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3425 Assembly A12 Or A13 Not Responding

Communication with both Oscillator assemblies is checked. A failure indicates that one or both assemblies are not responding.

3426 A12: 8255 Was Reset

The control word of the 8255 on the Oscillator Control assembly is read. A failure indicates the Oscillator Control assembly (A12) is probably at fault.

3427 A13: 8255 Was Reset

The control word of the 8255 on the Oscillator Output assembly is read. A failure indicates the Oscillator Output assembly (A13) is probably at fault.

3500 A16: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Power Amp assembly. A failure indicates the Power Amp assembly (A16) is probably at fault.

3501 A16: 8255 Port A

The diagnostics software writes and reads data to port A of the 8255 IC on the Power Amp assembly. A failure indicates the Power Amp assembly (A16) is probably at fault.

3502 A16: 8255 Port B

The diagnostics software reads port B of the 8255 IC on the Power Amp assembly. A failure indicates the Power Amp assembly (A16) is probably at fault.

3503 A16: 8255 Port C

The diagnostics software read port C of the 8255 IC on the Power Amp assembly. A failure indicates the Power Amp assembly (A16) is probably at fault.

3504 Spare

This fault code is not used.

3505 Spare

This fault code is not used.

3506 Spare

This fault code is not used.

3507 A16: PA Supplies Are Off

The instrument is dormant. The +PA and -PA supplies are measured by connecting MUX1 and MUX2 respectively to the SDL line where they are measured by the adc circuit on the DAC assembly. This failure occurs if the measured voltage is between 40-80V. The test switch S201 on the Filter/PA Supply assembly (A18) appears to be in the test position.

3508 A16/A14: 220V AC Range Output Fault

The instrument is configured for operation at 22.1V at 1 kHz, 22.1V at 100 Hz, 100V at 1 kHz, 100V at 80 Hz, 100V at 500 Hz, 219V at 1 kHz, and 219V at 50 Hz. The output of the Power Amplifier is routed to the High Voltage Control assembly where it is divided and converted to a dc voltage by a peak detector circuit. This dc voltage which is equal to the peaks of the ac amplitude is connected to the SDL line where it is measure by the adc circuit on the DAC assembly to be the nominal ±10%. Exit diagnostics and set the instrument for the previous configuration and using a DMM measure the ac voltage output of the Power Amplifier, COM=TP10 HI=TP6. If the voltage is out of tolerance the Power Amplifier assembly (A16) is probably at fault. If the voltage is within tolerance, the the High Voltage Control assembly (A14) is probably at fault.

3509 A16: Amplifier Loop Not Regulated

The instrument is configured into three modes of operation. The first two modes is with the instrument set to the dc 220V range. The first is with the Power Amplifier input voltage being the 6.5V reference voltage (BRF6, BSRF6) resulting in a -130V Power Amplifier output. The second is the normal 220V dc operation with the input voltage from the DAC assembly. In this mode the Power Amplifier is outputting 22.1V, 100V, 219V, and -219V. The third is the ac 220V range at 22.1V at 1 kHz, 22.1V at 100 Hz, 100V at 1 kHz, 100V at 80 Hz, 100V at 500 Hz, 219V at 1 kHz, and 219V at 50 Hz. The output of the Power Amplifier input stage is measure to be less than 11V by connecting MUX0 to the SDL line where it is measured by the adc circuit on the DAC assembly. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3510 A16: 220V Amp Fault

The instrument is set to the dc 220V range with two modes of operation. The first is with the Power Amplifier input voltage being the 6.5V reference voltage (BRF6, BSRF6) resulting in a -130V Power Amplifier output. The second is the normal 220V dc operation with the input voltage from the DAC assembly. In this mode the Power Amplifier is outputting 22.1V, 100V, 219V, and -219V. In each mode the Power Amplifier output voltage is measured to be the nominal ±10% by connecting MUX3 to the SDL line where it is measured by the adc circuit on the DAC assembly. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3511 A16: Incorrect PA Input

The instrument is set to the dc 220V range with two modes of operation. The first is with the Power Amplifier input voltage being the 6.5V reference voltage (BRF6, BSRF6) resulting in a -130V Power Amplifier output. The second is the normal 220V dc operation with the input voltage from the DAC assembly. In this mode the Power Amplifier is outputting 22.1V, 100V, 219V, and -219V. The 6.5V reference input or the resulting -1.105V, -5.0V, -10.95V, and 10.95V respectively from the DAC, is measured to be the nominal ±10% by connecting MUX5 to the SDL line where it is measured by the adc circuit on the DAC assembly. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3512 Spare

This fault code is not used.

3513 Spare

This fault code is not used.

3514 Spare

This fault code is not used.

3515 Spare

This fault code is not used.

3516 Spare

This fault code is not used.

3517 Spare

This fault code is not used.

3518 Spare

This fault code is not used.

3519 Spare

This fault code is not used.

3520 A16: PA Oven Regulation Fault

The heater voltage of the Power Amp hybrid is measured by connecting MUX7 to the SDL line where it is measured by the adc circuit on the DAC assembly to ensure the hybrid is warmed up and regulating. The heater voltage is measured to be 0.7V ±10% ±0.2V. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3521 Assembly A16 Is Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Power Amplifier is not responding. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3522 Spare

This fault code is not used.

3523 Spare

This fault code is not used.

3524 A16: Power Amp Is Too Hot

The temperature of the Power Amp assembly is checked by connecting the output of the Temperature Sensor (MUX4) to the SDL line where it is measured by the adc circuit on the DAC assembly. This fault occurs if the measured voltage is over 1.7V. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3525 220V DC Initialization Fault

This fault occurs if the diagnostics software was unable to properly set the Power Amplifier assembly hardware for diagnostics testing. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3526 220V AC Initialization Fault

This fault occurs if the diagnostics software was unable to properly se the Power Amplifier assembly hardware for diagnostics testing in the AC mode. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3527 A16: Power Amp DC Cal Network Zero Fault

The instrument is dormant. The offset of the 220V DC INT. CAL NETWORK circuit on the Power Amplifier is measured by connecting its input to ACOM and the output is connected to the RCL line. RCL is routed to the +input of the adc circuit on the DAC assembly and the -input is connected to the DAC output which is adjusted until a null is achieved. This fault occurs if the DAC assembly was unable to converge. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3528 A16: Power Amp DC Cal Network Gain Fault

The instrument is dormant. The gain of the 220V INT. CAL NETWORK circuit on the Power Amplifier is measured by connecting its input to the 13V reference (BRF13, BSRF13) and the output is connected to the RCL line. RCL is routed to the +input of the adc circuit on the DAC assembly and the -input is connected to the DAC output which is adjusted until a null is achieved. This fault occurs if the nominal gain of 0.125 is over 7%. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3529 A16: Power Amp 220V Range Attenuator Fault

The Power Amplifier is configured to the dc 220V range with the input voltage being the 6.5V reference BRF6 and BSRF6. The resulting -130V at the output is connected to the input of the 220V RANGE AC ATTENUATOR circuit which has a nominal gain of -.01. The resulting +1.3V at its output is measured to be within 10% by connecting it to the RCL line and routing it to the +input of the adc circuit on the DAC assembly. The DAC output is connected to the -input and adjusted until a null is achieved. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3530 A16: 8255 Was Reset

The control word of the 8255 on the Power Amplifier is read. A failure indicates the Power Amplifier assembly (A16) is probably at fault.

3600 +17S Supply Fault

The instrument is dormant and the +17 S supply is out of tolerance. Measure the +17 S voltage on the Regulator/Guard Crossing assembly (A17). COM = TP9, HI = TP8. The voltage should be +17.0V to +18.0V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Switch Matrix assembly (A8) is faulty.

3601 -17S Supply Fault

The instrument is dormant and the -17 S supply is out of tolerance. Measure the -17 S voltage on the Regulator/Guard Crossing assembly (A17). COM = TP9, HI = TP12. The voltage should be -17.0V to -18.7V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Switch Matrix assembly (A8) is faulty.

3602 +15S Supply Fault

The instrument is dormant and the +15 S supply is out of tolerance. Measure the +15 S voltage on the Regulator/Guard Crossing assembly (A17). COM = TP9, HI = TP18. The voltage should be +14.2V to +15.8V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Output assembly (A13) is faulty.

3603 -15S Supply Fault

The instrument is dormant and the -15 S supply is out of tolerance. Measure the -15 S voltage on the Regulator/Guard Crossing assembly (A17). COM = TP9, HI = TP19. The voltage should be -14.2V to -15.8V. If the voltage is out of tolerance, the Regulator/Guard Crossing is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Output assembly (A13) is faulty.

3604 +42S Supply Fault

The instrument is dormant and the +44 S supply is out of tolerance. Measure the unregulated +44 S voltage on the Filter/PA Supply assembly (A18). COM = TP22, HI = TP7. The voltage should be +45V to +75V. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is faulty. If the voltage is within tolerance, measure the regulated +44 S on the Regulator assembly. (A17) COM = TP9, HI = TP13. The voltage should be +42.0V to +45.6V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Output assembly (A13) is faulty.

3605 -42S Supply Fault

The instrument is dormant and the -44 S supply is out of tolerance. Measure the unregulated -44 S voltage on the Filter/PA Supply assembly (A18). COM = TP22, HI = TP9. The voltage should be -45V to -75V. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is faulty. If the voltage is within tolerance, measure the regulated -44 S on the Regulator assembly. (A17) COM = TP9, HI = TP16. The voltage should be -42.0V to -45.6V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Output assembly (A13) is faulty.

3606 LH COM Ground Fault

The Current/Hi Res assembly (A7) connects LHCOM to the SDL line where it is measured by the adc circuit on the DAC assembly for 0V ±50 mV relative to RCOM.

3607 -5LH Supply Fault

The instrument is dormant and the -5 LH supply is out of tolerance. Measure the unregulated -5 LH voltage on the Filter/PA Supply assembly (A18). COM = TP3, HI = TP6. The voltage should be -8V to -16V. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is faulty. If the voltage is within tolerance, measure the regulated -5 LH on the Regulator assembly. (A17) COM = TP10, HI = TP15. The voltage should be -4.7V to -5.3V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Switch Matrix assembly (A8) is faulty.

3608 +5RLH Supply Fault

The instrument is dormant and the +5 RLH supply is out of tolerance. Measure the +5 RLH voltage on the Regulator/Guard Crossing assembly (A17). COM = TP10, HI = TP14. The voltage should be +4.9V to +5.5V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Switch Matrix assembly (A8) is faulty.

3609 +8RLH Supply Fault

The instrument is dormant and the +8RLH supply is out of tolerance. Measure the +8RLH voltage on the Regulator /Guard Crossing assembly (A17). COM = TP10, HI = TP17. The voltage should be +10V to +20V. If the voltage is out of tolerance, replace fuse F1 on the Regulator/Guard Crossing assembly. (A17) If the voltage is within tolerance, the diagnostic circuit on the Switch Matrix assembly (A8) is faulty.

3610 +PA Supply Fault

The instrument is configured to the dc 220V range. The Power Amplifier is set for 22.1V, 219V, and -219V and the +PA supply is measured for the nominal +180V and +360V ±10% by connecting MUX1 to the SDL line which is measured by the adc circuit on the DAC assembly. In order to identify the faulty assembly the +PA supply will have to be measured. Power off the instrument and remove the Power Amplifier assembly from the chassis.

NOTE

All of the following connections and measurements are done on the Filter/PA Supply assembly (A18) in order to verify operation of the +PA supply.

Connect DMM COM to TP203 and the high to TP201. Using a jumper, connect TP207 to TP203 and power on the instrument. The DMM should read +180V ±10%. Using another jumper connect TP205 to TP203. The DMM should read +360V ±10%. If either voltage is out of tolerance the Filter/PA Supply assembly (A18) is probably at fault. If the voltages are within tolerance, the Power Amplifier assembly (A16) is probably at fault.

3611 -PA Supply Fault

The +PA supply is set to +180V and +360V and measured at each setting to be within 10% of the nominal. Reset the instrument. Measure the logic level of TP205 and TP207 on the Filter/PA Supply assembly (A18). TP205 should be a logic high (8V) and TP207 should be a logic low. If these logic levels are incorrect the Digital Control circuit on the Power Amplifier assembly (A16) is faulty. If these logic levels are correct measure the +PA supply on the Filter/PA Supply assembly. COM = TP203, HI = TP201. The voltage should be 180V ±10%. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is probably at fault. If the voltage is within tolerance, call up 200V via the instrument keyboard. The +PA supply should go the 360V ±10%. If the voltage is within tolerance, the diagnostic circuit on the Power Amplifier assembly (A16) is probably at fault. If the voltage is out of tolerance, check TP205 on the Filter/PA Supply assembly for a logic low before assuming the Filter/PA Supply assembly is at fault.

3612 +15OSC Supply Fault

The instrument is dormant and the +15 OSC supply is measured to be within +14.2 to +15.8V. Measure the unregulated +15 OSC voltage on the Filter/PA Supply assembly (A18). COM = TP4, HI = TP2. The voltage should be +19V to +35V. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is faulty. If the voltage is within tolerance, measure the regulated +15 OSC on the Regulator assembly (A17). COM = TP4, HI = TP3. The voltage should be +14.2V to +15.8V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Control assembly (A12) is faulty.

3613 -15OSC Supply Fault

The instrument is dormant and the -15 OSC supply is measured to be within -14.2 to -15.8V. Measure the unregulated -15 OSC voltage on the Filter/PA Supply assembly (A18). COM = TP4, HI = TP5. The voltage should be -19V to -35V. If the voltage is out of tolerance, the Filter/PA Supply assembly (A18) is faulty. If the voltage is within tolerance, measure the regulated -15 OSC on the Regulator assembly (A7). COM = TP4, HI = TP5. The voltage should be -14.2V to -15.8V. If the voltage is out of tolerance, the Regulator/Guard Crossing assembly (A17) is faulty. If the voltage is within tolerance, the diagnostic circuit on the Oscillator Control assembly (A12) is faulty.

3614 OSC COM Ground Fault

The Oscillator Control assembly (A12) connects OSC COM to the SDL line where it is measured by the adc circuit on the DAC assembly for 0V ±50 mV relative to RCOM.

3615 S COM Ground Fault

The Current/Hi Res assembly (A7) connects SCOM to the SDL line where it is measured by the adc circuit on the DAC assembly for 0V ±50 mV relative to RCOM.

3700 A21: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Rear Panel assembly. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3701 A21: 8255 Port A Fault

The diagnostics software writes and reads data to port A of the 8255 IC on the Rear Panel assembly. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3702 A21: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the Rear Panel assembly. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3703 A21: 8255 Port C Fault

The diagnostics software read port C of the 8255 IC on the Rear Panel assembly. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3704 Assembly A21 Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Rear Panel is not responding. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3705 A21: Rear Panel Data Bus Fault

The diagnostics software writes and reads from a register in the DUART on the Rear Panel assembly. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3706 Spare

This fault code is not used.

3707 Spare

This fault code is not used.

3708 A21: 8255 Was Reset

The control word of the 8255 on the Rear Panel assembly is read. A failure indicates the Rear Panel assembly (A21) is probably at fault.

3800 A8: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Switch Matrix assembly. A failure indicates the Switch Matrix assembly (A8) is probably at fault.

3801 A8: 8255 Port A Fault

The diagnostics software writes and reads to port A of the 8255 IC on the Switch Matrix assembly. A failure indicates the Switch Matrix assembly (A8) is probably at fault.

3802 A8: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the Switch Matrix assembly. A failure indicates the Switch Matrix assembly (A8) is probably at fault.

3803 A8: 8255 Port C Fault

The diagnostics software reads port C of the 8255 IC on the Switch Matrix assembly. A failure indicates the Switch Matrix assembly (A8) is probably at fault.

3804 A8: Zero Amp Lo Noise Fault

The Internal Cal Zero Amplifier circuit on the Switch Matrix assembly is tested for noise in the low gain configuration. This is done by connecting the circuit input to RCOM, by turning on Q7, and connecting the output to the RCL line where it is measured by the adc circuit on the DAC assembly. The adc circuit takes ten readings and this failure occurs if the difference between the lowest value and highest value of the ten readings is over 0.0001V. A failure indicates the Switch Matrix assembly (A8) is probably at fault.

3805 A8: Zero Amp Lo Offset

The Internal Cal Zero Amplifier circuit on the Switch Matrix assembly is tested for excessive offset in the low gain configuration. This is done by connecting the circuit input to RCOM, by turning on Q7, and connecting the output to the RCL line where it is measured by the adc circuit on the DAC assembly. The adc circuit takes ten readings and this failure occurs if the average value is over 0.035V. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3806 A8: Zero Amp Lo Gain Fault

The gain of the Internal Cal Zero Amplifier circuit in the low gain (10) configuration is tested. The circuit input is connected to the output of the DAC assembly and the circuit output is connected to the RCL line. The RCL line is connected to the +input of the adc circuit and the -input is connected to the 6.5V reference. The gain of the Internal Cal Zero Amplifier is determined by setting the DAC output to the nominal 0.65V and then adjusted it until a null is achieved. The gain is tested to be 10 ±6%. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3807 A8: Zero Amp Hi Noise Fault

The Internal Cal Zero Amplifier circuit on the Switch Matrix assembly is tested for noise in the high gain configuration. This is done by connecting the circuit input to RCOM, by turning on Q7, and connecting the output to the RCL line where it is measured by the adc circuit on the DAC assembly. The adc circuit takes ten readings and this failure occurs if the difference between the lowest value and highest value of the ten readings is over 0.0015V. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3808 A8: Zero Amp Hi Offset

The Internal Cal Zero Amplifier circuit on the Switch Matrix assembly is tested for excessive offset in the high gain configuration. This is done by connecting the circuit input to RCOM, by turning on Q7, and connecting the output to the RCL line where it is measured by the adc circuit on the DAC assembly. The adc circuit takes ten readings and this failure occurs if the average value is over 0.155V. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3809 A8: Zero Amp Hi Gain Fault

The gain of the Internal Cal Zero Amplifier circuit in the high gain (130) configuration is tested. The circuit input is connected to the output of the DAC assembly and the circuit output is connected to the RCL line. The RCL line is connected to the +input of the adc circuit and the -input is connected to the 6.5V reference. The gain of the Internal Cal Zero Amplifier is determined by setting the DAC output to the nominal 0.05V and then adjusted it until a null is achieved. The gain is tested to be 130 ±6%. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3810 A8: 2.2V Amp Noise Fault

3811 A8: Zero Amp Offset

3812 A8: 2.2V Gain Fault

3813 A8: 220mV Offset Fault

3814 A8: 220mV Divider Fault

3815 A8: 22mV Divider Fault

3816 Spare

This fault code is not used.

3817 Spare

This fault code is not used.

3818 A8: Out Lo To Sense Lo Continuity Fault

3819 A8: Relay Fault

A fault occurred while doing relay testing on the Switch Matrix assembly.

3820 Spare

This fault code is not used.

3821 Spare

This fault code is not used.

3822 Spare

This fault code is not used.

3823 Spare

This fault code is not used.

3824 A8: Oven Regulation Fault

The heater voltage of the Switch Matrix HR1 hybrid assembly is measured to ensure it is warmed up and regulating by connecting OVEN TEMP to the SDL line where it is measured by the adc circuit on the DAC assembly. OVEN TEMP is measured to be 0.7V ±10% ±0.2V. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3825 Assembly A8 Not Responding

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Switch Matrix assembly is not responding. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3826 A8: 8255 Was Reset

The control word of the 8255 on the Switch Matrix assembly is read. A failure indicates the Switch Matrix (A8) assembly is probably at fault.

3827 Assembly A8 Too Hot

3900 A5: 8255 Control Word

The diagnostics software reads the control word of the 8255 IC on the Wideband Output assembly. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3901 A5: 8255 Port A Fault

The diagnostics software writes and reads data to port A of the 8255 IC on the Wideband Output assembly. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3902 A5: 8255 Port B Fault

The diagnostics software reads port B of the 8255 IC on the Wideband Output assembly. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3903 A5: 8255 Port C Fault

The diagnostics software reads port C of the 8255 IC on the Wideband Output assembly. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3904 Optional Assemblies A5/A6 Are Missing

At power up the instrument checks to see what assemblies are not installed. This test verifies that the Wideband Output is not responding. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3905 A6: Phase Lock Loop At 10Mhz

The Wideband assemblies are configured to 3.5V at 1.3 MHz, 1.2V at 1.3 MHz, 2.0V at 3.0 MHz, 1.0V at 4.1 MHz, 3.3V at 5.0 MHz, 2.0V at 6.0 MHz, 2.0V at 7.0 MHz, and 2.0V at 7.9 MHz. The input voltage to the VCO circuit on the Wideband Oscillator assembly is resistively divided creating WB PLL DIAGNOSTICS which is routed to the Wideband Output assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This fault occurs if the input voltage to the VCO is not within 25% ±0.75V of the expected value. A failure indicates the Wideband Oscillator (A6) assembly is probably at fault.

3906 A6: Phase Lock Loop At 30Mhz

The Wideband assemblies are configured to 3.5V at 30.0 MHz and 1.2V at 30.0 MHz. The input voltage to the VCO circuit on the Wideband Oscillator assembly is resistively divided creating WB PLL DIAGNOSTICS which is routed to the Wideband Output assembly where it is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This fault occurs if the input voltage to the VCO is not within 25% ±0.75V of the expected value. A failure indicates the Wideband Oscillator (A6) assembly is probably at fault.

3907 A5: RMS Sensor At 10Mhz

The Wideband assemblies are configured to 3.5V at 1.3 MHz, 1.2V at 1.3 MHz, 2.0V at 3.0 MHz, 1.0V at 4.1 MHz, 3.3V at 5.0 MHz, 2.0V at 6.0 MHz, 2.0V at 7.0 MHz, and 2.0V at 7.9 MHz. SENSOR CAL which is the output from the RMS Sensor and Amplitude Control circuit on the Wideband Output assembly is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This fault occurs if RMS Sensor output is not within 15% of the expected value. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3908 A5: RMS Sensor At 30Mhz

The Wideband assemblies are configured to 3.5V at 30.0 MHz and 1.2V at 30.0 MHz. SENSOR CAL which is he output from the RMS Sensor and Amplitude Control circuit on the Wideband Output assembly is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This fault occurs if RMS Sensor output is not within 15% of the expected value. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3909 A5: RMS Sensor At 6.5V DC in

The 6.5V reference (BRF6, BSRF6) is connected to the input of the RMS Sensor circuit on the Wideband Output assembly. The nominal 6.5V output of the Sensor is divided and buffered before being measured via the SENSOR CAL line. SENSOR CAL is connected to the SDL line for measurement by the adc circuit on the DAC assembly. This fault occurs if the output of the Sensor is not 6.5V ±0.47V. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3910 A5/A6: Ampl. Control At 10Mhz

The Wideband assemblies are configured for a 3.5V and 1.2V output at 1.3 MHz. WB AMPLITUDE CONTROL which is the control signal to the Wideband Oscillator assembly is divided and connected to the SDL line for measurement by the adc circuit on the DAC assembly. At the 3.5V level it is checked to be 4.5V ±1.0V and at the 1.2V level it is checked for 0.0V ±0.7V. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3911 A5/A6: Ampl. Control At 30Mhz

The Wideband assemblies are configured for a 3.5V and 1.2V output at 30.0 MHz. WB AMPLITUDE CONTROL which it the control signal to the Wideband Oscillator assembly is divided and connected to the SDL line for measurement by the adc circuit on the DAC assembly. At the 3.5V level it is checked to be 4.8V ±1.0V and at the 1.2V level it is checked for 0.0V ±0.8V. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3912 A5/A6: Output Offset At 10Mhz

The Wideband assemblies are configured to 3.5V at 1.3 MHz, 1.2V at 1.3 MHz, 2.0V at 3.0 MHz, 1.0V at 4.1 MHz, 3.3V at 5.0 MHz, 2.0V at 6.0 MHz, 2.0V at 7.0 MHz, and 2.0V at 7.9 MHz. The output of the Unity Gain Amplifier circuit on the Wideband Output assembly is measured via the OUTPUT OFFSET line to ensure the dc offset is less than 20 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3913 A5/A6: Output Offset At 30Mhz

The Wideband assemblies are configured to 3.5V at 30.0 MHz and 1.2V at 30.0 MHz. The output of the Unity Gain Amplifier circuit on the Wideband Output assembly is measured via the OUTPUT OFFSET line to ensure the dc offset is less than 20 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3914 A5: 0DB Output Attenuation Fault

The 6.5V reference (BRF6, BSRF6) is connected to the Unity Gain Amplifier circuit on the Wideband Output assembly which drives the output through the Attenuators. The Wideband Output assembly is set for 0 dB attenuation so the 6.5V input results in a 3.25V output into 50Ω. This 3.25V is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. The DAC assembly output is connected to the -input of the adc circuit and adjusted until a null is achieved. This determines the exact value of the Wideband output. This fault occurs if the determined Wideband output is over 6% ±1.0 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3915 A5: 10DB Output Attenuation Fault

The 6.5V reference (BRF6, BSRF6) is connected to the Unity Gain Amplifier circuit on the Wideband Output assembly which drives the output through the Attenuators. The Wideband Output assembly is set for 10 dB attenuation so the 6.5V input results in a 1.027V output into 50Ω. This 1.027V is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. The DAC assembly output is connected to the -input of the adc circuit and adjusted until a null is achieved. This determines the exact value of the Wideband output. This fault occurs if the determined Wideband output is over 6% ±1.0 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3916 A5: 20DB Output Attenuation Fault

The 6.5V reference (BRF6, BSRF6) is connected to the Unity Gain Amplifier circuit on the Wideband Output assembly which drives the output through the Attenuators. The Wideband Output assembly is set for 20 dB attenuation so the 6.5V input results in a 0.325V output into 50Ω. This 0.325V is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. The DAC assembly output is connected to the -input of the adc circuit and adjusted until a null is achieved. This determines the exact value of the Wideband output. This fault occurs if the determined Wideband output is over 6% ±1.0 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3917 A5: 30DB Output Attenuation Fault

The 6.5V reference (BRF6, BSRF6) is connected to the Unity Gain Amplifier circuit on the Wideband Output assembly which drives the output through the Attenuators. The Wideband Output assembly is set for 30 dB attenuation so the 6.5V input results in a 0.103V output into 50Ω. This 0.103V is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. The DAC assembly output is connected to the -input of the adc circuit and adjusted until a null is achieved. This determines the exact value of the Wideband output. This fault occurs if the determined Wideband output is over 6% ±1.0 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3918 A5: 40DB Output Attenuation Fault

The 6.5V reference (BRF6, BSRF6) is connected to the Unity Gain Amplifier circuit on the Wideband Output assembly which drives the output through the Attenuators. The Wideband Output assembly is set for 40 dB attenuation so the 6.5V input results in a 0.032V output into 50Ω. This 0.032V is connected to the RCL line which is routed to the +input of the adc circuit on the DAC assembly. The DAC assembly output is connected to the -input of the adc circuit and adjusted until a null is achieved. This determines the exact value of the Wideband output. This fault occurs if the determined Wideband output is over 6% ±1.0 mV. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3919 Spare

This fault code is not used.

3920 Spare

This fault code is not used.

3921 Spare

This fault code is not used.

3922 A5/A6: Wideband Initialization Fault

This fault occurs if the diagnostics software was unable to properly set the Wideband assembly hardware for diagnostics testing. A failure indicates the Wideband Output (A5) assembly is probably at fault.

3923 A5: 8255 Was Reset

The control word of the 8255 on the Wideband Output is read. A failure indicates the Wideband Output (A5) assembly is probably at fault.

COMPONENT-LEVEL TROUBLESHOOTING 5-3.

WARNING

SERVICING DESCRIBED IN THIS SECTION IS TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

The remaining part of Section 5 is devoted to troubleshooting the 5700A analog modules to the component level. Use the following information alongside the schematic diagrams as a guide in troubleshooting if you do not wish to replace a faulty module through the Fluke Module Exchange Program. (Refer to Section 1 for module exchange instructions.)

NOTE

To access the 5700A assemblies for troubleshooting during operation, you will need the 5700A-7001K Extender Card Kit, Fluke P/N 857409.

Troubleshooting the Wideband Output Assembly (A5) 5-4.

Proceed as follows to troubleshoot the Wideband Output assembly (A5):

1. Install the Wideband Output assembly on the extender card with its large right front shield removed. The rear shield should remain in place. Connect a 50Ω load to the Wideband Output at the type "N" connector on the 5700A front panel. Power up the 5700A and call up the Wideband function.

NOTE

All measurements are referenced to SCOM (TP16) and all 5700A outputs are from the Wideband Option unless otherwise noted.

2. Check the Oscillator input and the 10 Hz to 1.1 MHz Buffer circuit. Set the 5700A to 3.5V at 1 kHz operate. Using a DMM measure the ac voltage at TP9 and verify it is 7V ±10%. If a failure is detected, check input relay K1A and its drive circuit. Next using a DMM measure the ac voltage at TP13 and verify it is also 7V ±10%. If a failure is detected, check U11B, Q17, K1B, K3B, K12, and associated components in the 10 Hz to 1.1 MHz Buffer Circuit.

3. Check the Unity Gain Amplifier circuit. Set the 5700A to 3.5V at 1 kHz operate. Using a DMM measure the ac voltage at TP14 and verify it is 3.5V ±10%. If a failure is detected, check Q11-Q16 and associated components is the Unity Gain Amplifier circuit.

4. Check the RMS Sensor and Amplitude Control circuit during Wideband operation below 12 kHz. Set the 5700A to 3.5V at 1 kHz, operate mode. Verify that FETs Q2 and Q3 are turned on by measuring the dc voltage at TP5. (It should be +17V ±10%.) If a failure is detected, check U4B and control line PB0. Using a DMM measure and note the ac voltage at TP7 and verify it is 7V ±10%. Measure the dc voltage at TP1 and verify it is the same as measured at TP7 ±10%. If a failure is detected, check U1, U2, U3, and associated components. Next measure the dc voltage at TP2 and verify it is 0.317 times the voltage at TP1 ±10%. If a failure is detected, check U5 and associated components.

NOTE

During Wideband operation, internal software monitors the output and makes corrections or trips the instrument to standby. This internal monitoring can cause problems when attempting to troubleshoot the Wideband Output assembly. If during the following step the 5700A trips to standby, defeat the monitoring by connecting a jumper from TP9 to TP10 on the DAC assembly.

5. Check the RMS Sensor and Amplitude Control circuit during Wideband operation from 12 kHz to 1.1 MHz. Set the 5700A to 3.5V at 12 kHz operate. Using a DMM measure and note the ac voltage at TP7 and verify it is 7V ±10%. Measure the dc voltage at TP1 and verify it is the same as measured at TP7 ±10%. If a failure is detected, check U1, U2, U3, and associated components. Next measure the dc voltage at TP2 and verify it is 0.317 times the voltage at TP1 ±10%. If a failure is detected, check U5 and associated components. Verify that FETs Q2 and Q3 are turned off by measuring the dc voltage at TP5. (It should be -11.4V ±20%.) If the voltage at TP5 is incorrect skip to step 8.

6. Check the WB Amplitude Control line. Remove jumper E3 from the J3 pins and connect an external variable dc reference voltage to TP18 (low to TP19). Set the 5700A to 3.5V at 12 kHz operate and set the external dc reference voltage to 2V. Using a DMM measure TP3 and verify it is a negative voltage. Next set the external dc reference voltage to 3V and verify TP3 changes to a positive voltage. If a failure is detected, check U12B and associated components.

NOTE

Remove the external dc reference and replace jumper E3 before continuing.

7. Check the X10 Amplifier circuit. Set the 5700A to 3.5V at 1.2 MHz, operate. Connect an Oscilloscope (set for ac coupling) to the input of the X10 Amplifier which is the junction with R46, R47, and R49. Verify the Oscilloscope displays a distortion-free 1.2 MHz sine wave. If a failure is detected, check the cable at J1 and the Wideband Output assembly. Note the amplitude of the input sine wave and move the Oscilloscope probe to TP13 and verify is displays a distortion-free 1.2 MHz sine wave which is ten times larger in amplitude. If a failure is detected check Q4-Q10 and associated components in the X10 Amplifier circuit.

8. Check the Overload Control circuit. Remove jumper E3 from the J3 pins and connect an external variable dc reference voltage to TP18 (low to TP19). Set the 5700A to 3.5V at 1.2 MHz operate and set the external dc reference voltage to 2V. Connect an Oscilloscope to TP5 and verify it is a negative voltage. Connect a DMM to TP1 and slowly increase the external dc reference in 10 mV steps until the voltage at TP5 goes positive. Verify the voltage at TP1 is 7.7V ±5%. If a failure is detected, check U4A, U4B, VR2, and associated components.

NOTE

Remove the external dc reference and replace jumper E3 before continuing.

9. Check the Attenuators. Connect a DMM to the 50Ω termination at the Wideband Output type "N" connector on the 5700A front panel. Set the 5700A for output voltages of 3V, 1V, 300 mV, and 30 mV, all at 1 kHz, and verify the DMM read the selected voltage ±5%. If a failure is detected, check K4-K8, Z1, and Z2. Next, connect the supplied output cable and 50Ω terminator to the WIDEBAND connector of the 5700A front panel. Refer to the 5700A Operators manual and run Wideband Gain calibration. After the Wideband Gain calibration is complete check the Wideband output at the end of the cable and 50Ω terminator at 3V, 1V, 300 mV, and 30 mV, all at 1 kHz, and verify the output is within 0.2%.

Troubleshooting the Wideband Oscillator Assembly (A6) 5-5.

Proceed as follows to troubleshoot the Wideband Oscillator assembly (A5):

1. Remove the front and rear shields from the Wideband Oscillator assembly and place it up on the extender card. Power up the 5700A and call up the Wideband function.

NOTE

All measurements are referenced to SCOM (TP16 or TP17) and all 5700A outputs are from the Wideband Option unless otherwise noted.

2. Set the 5700A to 1V at 1.2 MHz, operate. Connect an oscilloscope to TP10, set it to 500 mV/div at 500 ns/div, and verify it displays a 1.2 MHz signal similar to that shown in Figure 5-1. Next, connect a frequency counter to TP10. Set the 5700A to 2 MHz, 5 MHz, 10 MHz, 20 MHz, and 30 MHz, verify that each frequency is within 0.01% of the nominal. If a failure is detected, proceed with step 3 otherwise skip to step 11.

3. Check the 8 MHz reference. Set the 5700A to 1V at 1.2 MHz operate. Connect an oscilloscope to TP1 and verify it displays a 8 MHz signal similar to that shown in Figure 5-2. If a failure is detected, first verify that control line WB ON/OFF* is a logic high by measuring U15 pin 5. If the signal is incorrect, the control line WB ON/OFF* from the Wideband Output (A5) assembly is probably at fault. If the control line is correct check U15A and associated components.

NOTE

The input CLK and CLK is a low-level (400 mV p-p) signal generated by the Regulator/Guard Crossing assembly.*

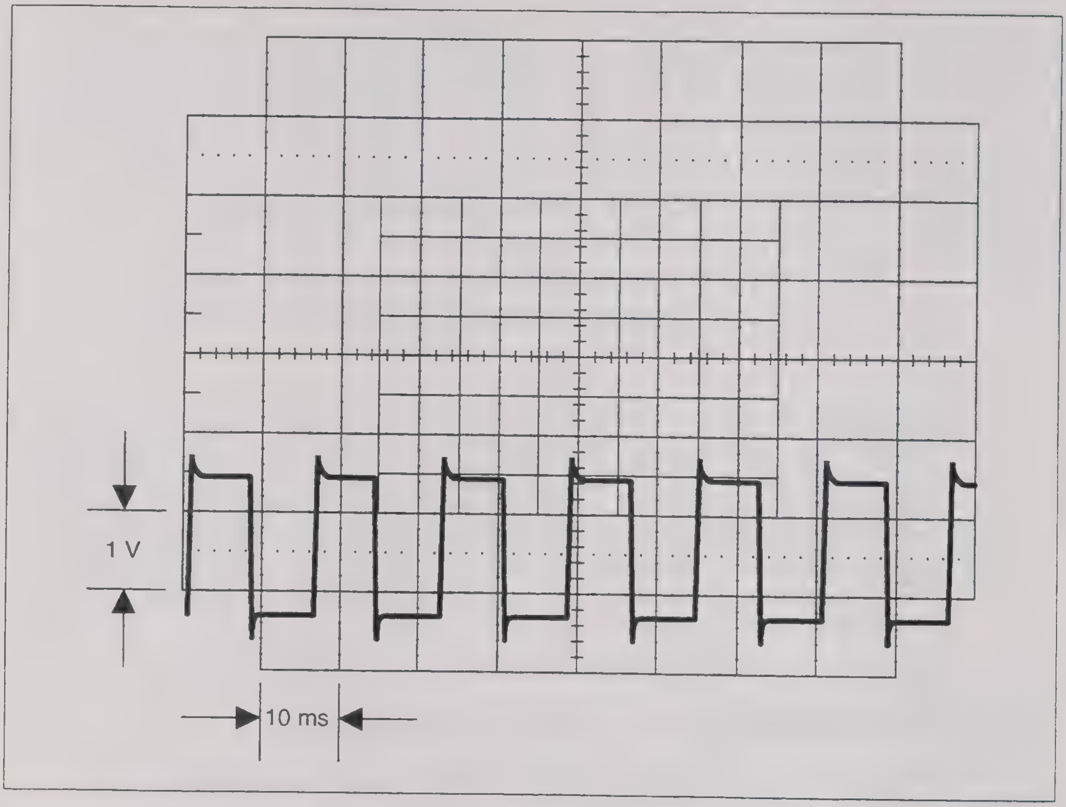

Figure 5-1. Waveform at TP10

4. Check the 4 MHz to 8 MHz feedback signal. Set the 5700A to 1V at 1.2 MHz, operate. Connect an oscilloscope to TP15 and verify it displays a 4.8 MHz signal similar to that shown in Figure 5-3. Use a frequency counter and verify that the frequency of this signal is 4.8 MHz ±0.01%. If a failure is detected, continue with step 5; otherwise skip to step 10.
5. Check the VCO Supply Voltage. Set the 5700A to 1V at 1.2 MHz, operate. Using a DMM measure the dc voltage at U3 pin 8 and verify it is -5V ±7%. If a failure is detected, check Q2, Q3, U7, and associated components.
6. Check the VCO circuit. Power down the 5700A, remove shorting header E6 from the J6 pins, and connect an external variable dc reference (2V to 13V) to TP2. Power up the 5700A and set it for 1V at 1.2 MHz, operate. Connect a frequency counter to TP3. Vary the external dc reference from 2 to 12V and verify the frequency counter reading changes from approximately 32 to 64 MHz. If a failure is detected, check the VCO circuit containing U3, CR1, CR2, and associated components.
7. Check the dividers in U4 and U5. Power down the 5700A, remove shorting header E6 from the J6 pins, and connect an external variable dc reference (2 to 13V) to TP2. Power up the 5700A and set it for 1V at 1.2 MHz, operate. Connect a frequency counter to TP3 and adjust the external dc reference until the frequency counter reads 64 MHz ±0.1%. Using the frequency counter, measure the frequency at TP4 and verify it reads 32 MHz ±0.1%. If a failure is detected, check U4 and associated components. Next, measure the frequency at pins 15, 13, 4, and 2 of U5 and verify that pin 15 measures 16 MHz ±0.1%, pin 13 measures 8 MHz ±0.1%, pin 4 measures 4 MHz ±0.1%, and pin 2 measures 2 MHz ±0.1%. If a failure is detected, check U5 and associated components.

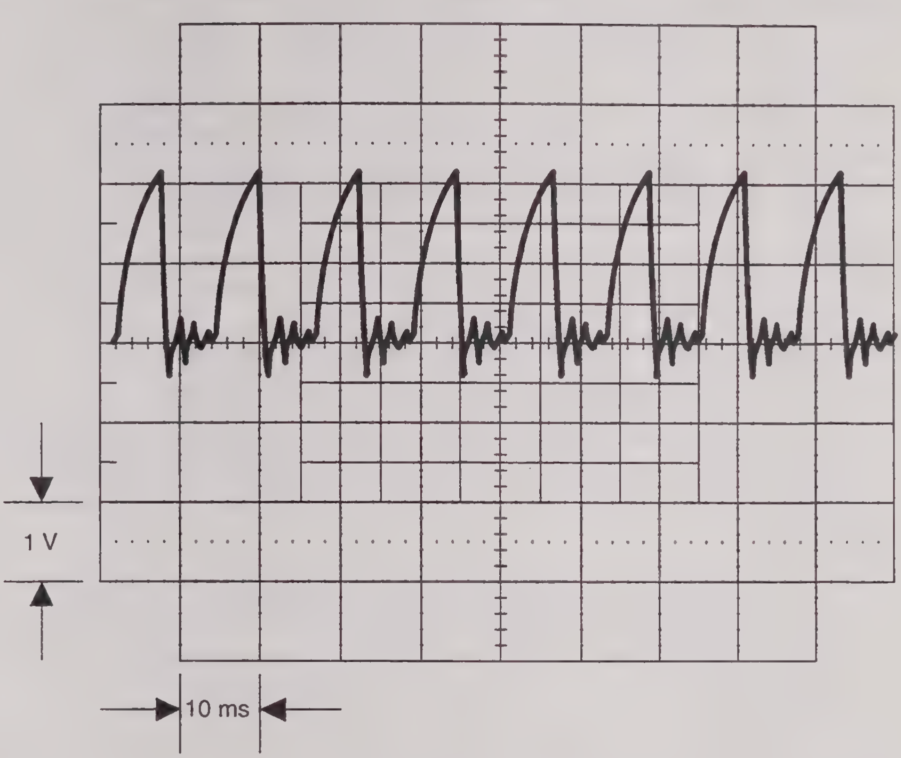

Figure 5-2. Waveform at TP1

8. Check the Synthesizer IC U1. Power down the 5700A, remove shorting header E6 from the J6 pins, and connect an external variable dc reference (2 to 13V) to TP2. Power up the 5700A and set it for 1V at 6 MHz, operate. Connect a frequency counter to TP15 and adjust the external dc reference until the counter reads less than 6 MHz (~5.8 MHz). Connect an oscilloscope to pin 15 of U1 and verify it displays a signal similar to Figure 5-4. Next, adjust the external dc reference until the counter reads more than 6 MHz (~6.2 MHz). Connect an oscilloscope to pin 14 of U1 and verify it displays a signal similar to Figure 5-4. If a failure is detected, check U1 and associated components.

9. Check the Amplifier Circuit. Power down the 5700A, remove shorting header E6 from the J6 pins, and connect an external variable dc reference (2 to 13V) to TP2. Power up the 5700A and set it for 1V at 6 MHz, operate. Connect a frequency counter to TP15 and adjust the external dc reference until the counter reads less than 6 MHz (~5.8 MHz). Connect an oscilloscope to pin 6 of U2 and verify it displays a positive dc voltage. Next, adjust the external dc reference until the counter read more than 6 MHz (~6.2 MHz) and verify the oscilloscope connected to pin 6 of U2 displays a negative dc voltage. If a failure is detected, check U2 and associated components.

NOTE

Power down the 5700A, remove the external dc reference, and replace shorting header E6 on the J6 pins before continuing.

10. Check the Multiplexer U6 and its control lines. Power up the 5700A and it to 1V at 1.2 MHz, operate. Connect a frequency counter to TP10 and measure the logic levels of the control lines at pins 7, 9, and 10 of U6 using the data in Table 5-1 following table. Verify the logic levels are correct and the output frequency at TP10 is within 0.01%. If a failure is detected, check U6, U7, and associated components.
11. Check the Amplitude Control Amplifier circuit. Disconnect the cable between the Wideband Oscillator assembly and Wideband Output assembly at J1 on the Wideband Output assembly. Set the 5700A to 1V at 1.2 MHz, operate. Connect an oscilloscope set for ac coupling to pin 6 of U9 and verify it displays a signal similar to Figure 5-5. If a failure is detected, check U9 and its associated components in the Amplitude Control Amplifier circuit.
12. Check the X10 Wideband Amplifier circuit. Disconnect the cable between the Wideband Oscillator assembly and Wideband Output assembly at J1 on the Wideband Output assembly. Set the 5700A to 1V at 1.2 MHz, operate. Connect an oscilloscope set for ac coupling to TP13 and verify is displays a signal similar to Figure 5-5, but approximately 10 times larger in amplitude. If a failure is detected, check Q4, Q5, Q6, and associated components in the X10 Wideband Amplifier circuit.
13. Check the Filter Select circuit. Disconnect the cable between the Wideband Oscillator assembly and Wideband Output assembly at J1 on the Wideband Output assembly. Set the 5700A to 1V at 1.2 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz. At each frequency range verify the collector of the corresponding transistor in U13 switches to a high (~+17V) level while all the others remain at a low (-11V) level. If a failure is detected, check U8, U10, U11, and U13.
14. Check the Filters. Disconnect the cable between the Wideband Oscillator assembly and Wideband Output assembly at J1 on the Wideband Output assembly. Set the 5700A to 1V at 1.2 MHz, 1.9 MHz, 2 MHz, 3.9 MHz, 4 MHz, 7.9 MHz, 8 MHz, 15.9 MHz, 16 MHz, and 30 MHz. Connect an oscilloscope to TP14 and verify it displays a distortion-free sine wave at each frequency. If a failure is detected, check the corresponding Filter circuit.

Troubleshooting the Current/Hi-Res Assembly (A7) 5-6.

The Current/Hi-Res assembly generates output current and contains the high-resolution oscillator onto which the Oscillator Control assembly phase locks. Since these two functions are independent except for their digital control, troubleshooting procedures for each portion are presented separately.

CURRENT SECTION 5-7.

Proceed as follows to troubleshoot the current section of the Current/Hi-Res assembly (A7):

1. In order to troubleshoot the Current generating circuitry it is necessary to break the loop and use an external ac reference as the input source. Turn off the 5700A and cut jumper E1. Connect an external variable ac reference to TP19 (common to TP20).
2. Place the Current/Hi-Res assembly on the analog reverse extender card and jumper the 5700A OUTPUT HI binding post to the OUTPUT LO binding post. Turn on the 5700A.

NOTE

All measurements are referenced to SCOM (TP20) unless otherwise specified.

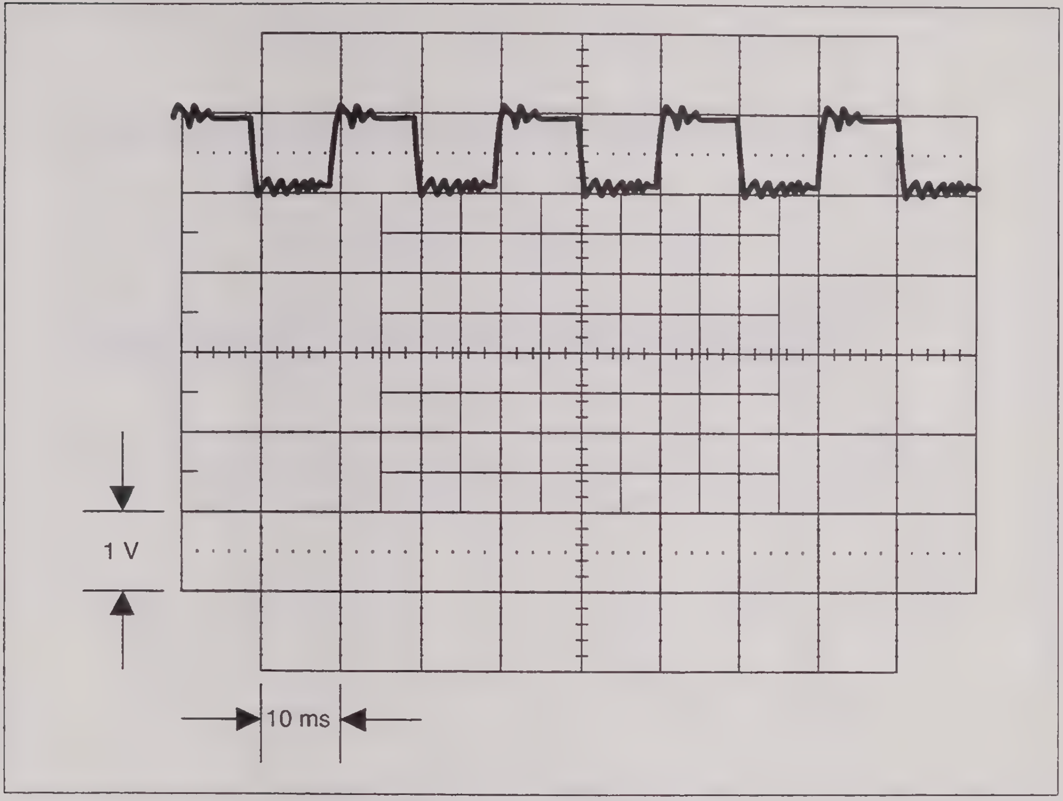

Figure 5-3. Waveform at TP15

3. Check the Complimentary Drive Circuit. Set the 5700A to 200 µA, standby. Set the external ac reference to 7.0V at 1 kHz. Connect an oscilloscope to pin 11 of K2 and verify that it displays a signal similar to Figure 5-6. Connect the oscilloscope to pin 6 of K2 and verify that it displays a signal similar to Figure 5-7. If a failure is detected, check Q2, Q3, Q18, Q19, K2, and their associated components in the Complimentary Drive Circuit.

4. Check the 220 µA range of the 220 µA/2.2 mA AMP circuit. Set the 5700A to 200 µA, standby. Set the external ac reference to 6.4V (±0.1V) at 1 kHz. Using a DMM, measure the ac voltage at the collector of Q4 and verify it is 2.0V ac ±10%. If a failure is detected, first verify that the 10 kΩ shunt on HR2 is correct and that it is connected to SCOM thought relays K5C, K5D, K10, K13 and the 1.2Ω load resistor R14 as in Figure 5-8. If the shunt and output switching is correct check Q4, Q5, K3, and the associated components in the 220 µA/2.2 mA AMP circuit.

5. Check the 2.2 mA Range of the 220 µA/2.2 mA AMP. Set the 5700A to 2 mA, standby. Set the external ac reference to 6.4V at 1 kHz. Measure the ac voltage at the collector of Q4 with a DMM and verify it is 2.0V ac ±10%. If a failure is detected, first verify the 1 kΩ shunt on HR2 is correct and it's connected to SCOM through relays in K7A, K5D, K10, K13 and 1.2Ω load resistor R14 as shown in Figure 5-9. If the shunt and output switching is correct check Q4, Q5, K3 and their associated components in the 220 µA/2.2 mA AMP circuit.

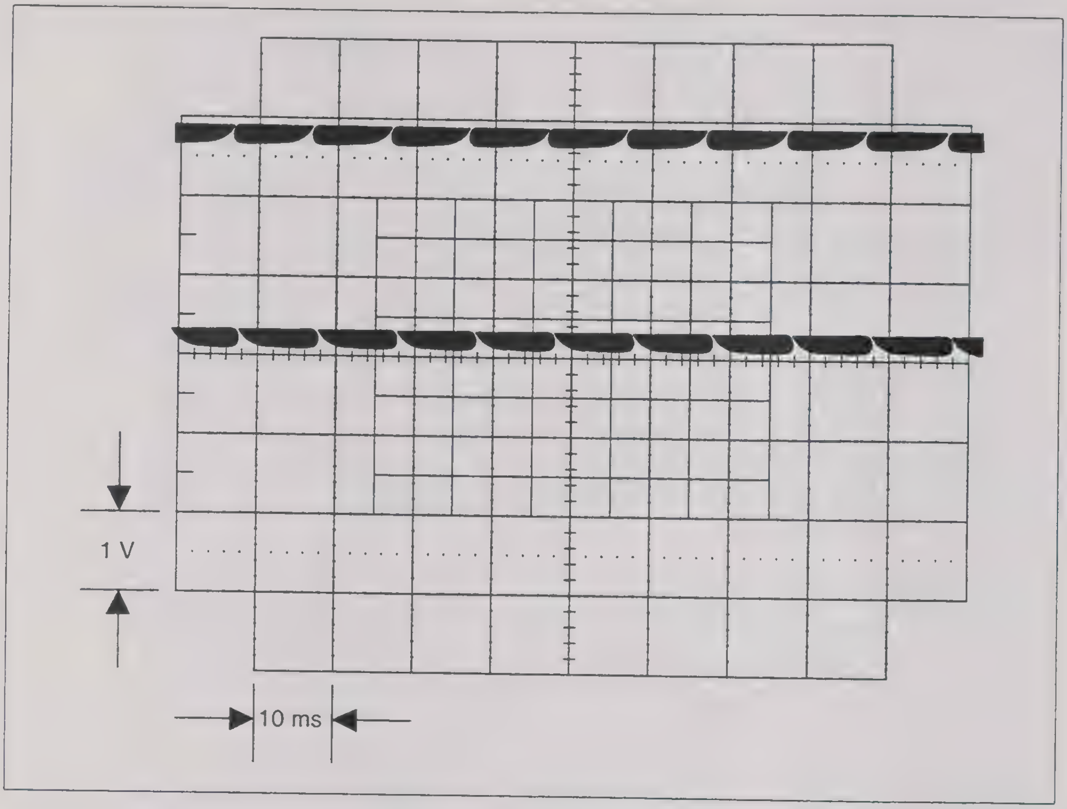

Figure 5-4. Waveform at Pins 14 and 15 of U1

Table 5-1. Verifying Multiplexer U6

5700A WIDEBAND OUTPUT	A PIN 7	B PIN 9	C PIN 10	TP10 1-32 MHz
1.2 MHz	-5V	-5V	-5V	1.2 MHz
2.0 MHz	0V	-5V	-5V	2.0 MHz
4.0 MHz	-5V	0V	0V	4.0 MHz
8.0 MHz	-5V	-5V	0V	8.0 MHz
16.0 MHz	0V	0V	-5V	16.0 MHz

6. Check the 22 mA Range of the 22 mA/220 mA AMP. Set the 5700A to 20 mA, standby. Set the external ac reference to 6.3V (±0.1V) at 1 kHz. Using a DMM measure the ac voltage at the collector of Q6 and verify it is 2.0V ac ±10%. If a failure is detected, first verify the 100Ω shunt on HR2 is correct and is connected to SCOM through relays in K8C, K7A, K5D, K10, K13, and 1.2Ω load resistor R14, as shown in Figure 5-10. If the shunt and output switching are correct, check Q6-Q13, K4, and the associated components in the 22 mA/220 mA AMP circuit.
7. Check the 220 mA Range of the 22 mA/220 mA AMP. Set the 5700A to 200 mA, standby. Set the external ac reference to 4.6V (±0.1V) at 1 kHz. Using a DMM measure the ac voltage at the collector of Q6 and verify it is 2.0V ac ±10%. If a failure first verify the 10Ω shunt on HR2 is correct and it's connected to SCOM through relays in K9C, K8C, K7A, K5D, K10, K13, and 1.2Ω load resistor R14 as shown in Figure 5-11. If the shunt and output switching are correct, check Q6-Q13, K4, and the associated components in the 22 mA/220 mA AMP circuit.

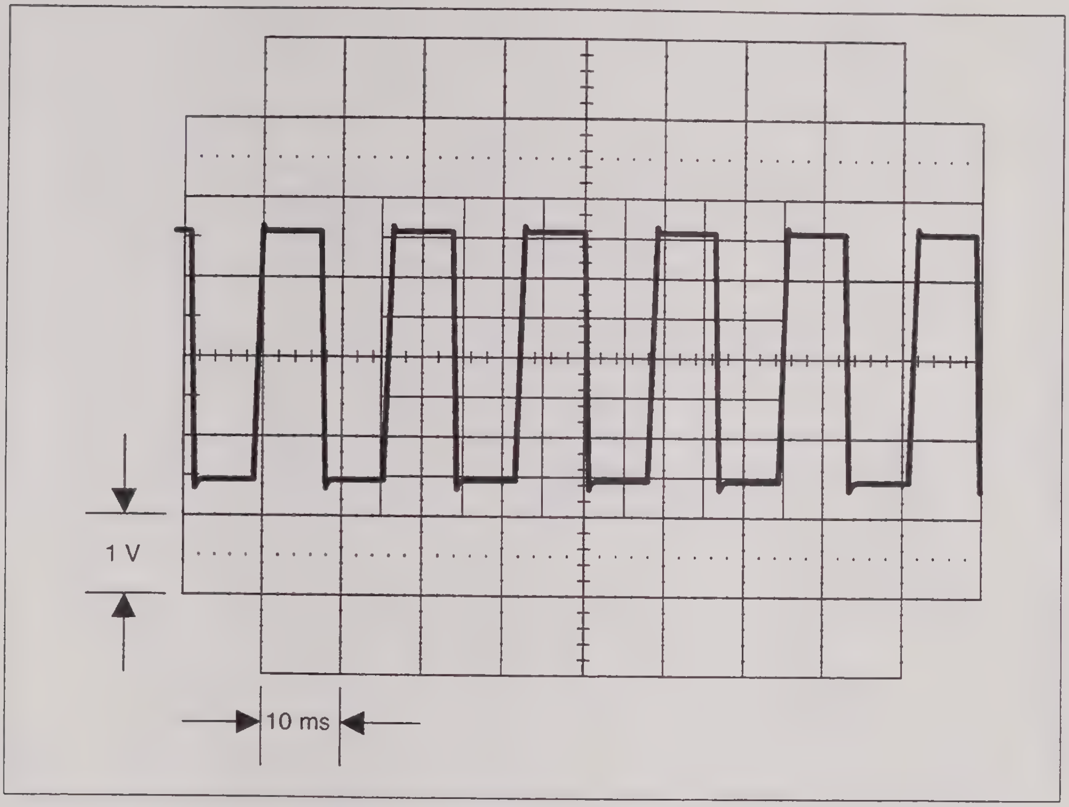

Figure 5-5. Waveform at Pin 6 of U9

8. Check the NEG. FB BUFFER. Set the 5700A to 200 mA, standby. Set the external ac reference to 4.6V at 1 kHz. Using a DMM measure the ac voltage at the collector of Q6 and note the reading. Next, measure the voltage at TP3 and verify it is the same as the previous noted reading ±0.01%. If a failure is detected, check U2, K5A, K6A, K8A, K9A and the associated components.
9. Check the POS. FB BUFFER. Set the 5700A to 200 mA, standby. Set the external ac reference to 4.6V at 1 kHz. Using a DMM measure the ac voltage at pin 5 of the HR2 resistor network and note the reading. Next, measure the voltage at TP4 and verify it is the same as the previous noted reading ±0.1%. If a failure is detected, check U3, K5B, K6B, K8B, K9B, and the associated components.
10. Check the I-GUARD BUFFER. Set the 5700A to 200 mA, standby. Set the external ac reference to 4.6V at 1 kHz. Measure the ac voltage at TP4 with a DMM and note the reading. Next, measure the voltage at U4 pin 6 and verify it is the same as the previous noted reading ±0.01%. If a failure is detected, check U4 and its associated components.

NOTE

Replace or reconnect jumper E1 and remove the external ac reference from the Current/Hi-Res assembly before continuing.

11. Check the Input Switching. Set the 5700A to 2 mA dc, operate. Using a DMM, measure the dc voltage at TP1 (common to TP2) and verify it is 20V dc ±0.25%. Next, set the 5700A to ac 2 mA at 1 kHz operate and measure the ac voltage at TP1 and verify it is 20V ac ±25%. If a failure is detected, check K1, Q20-Q23, and their appropriate drive circuitry.

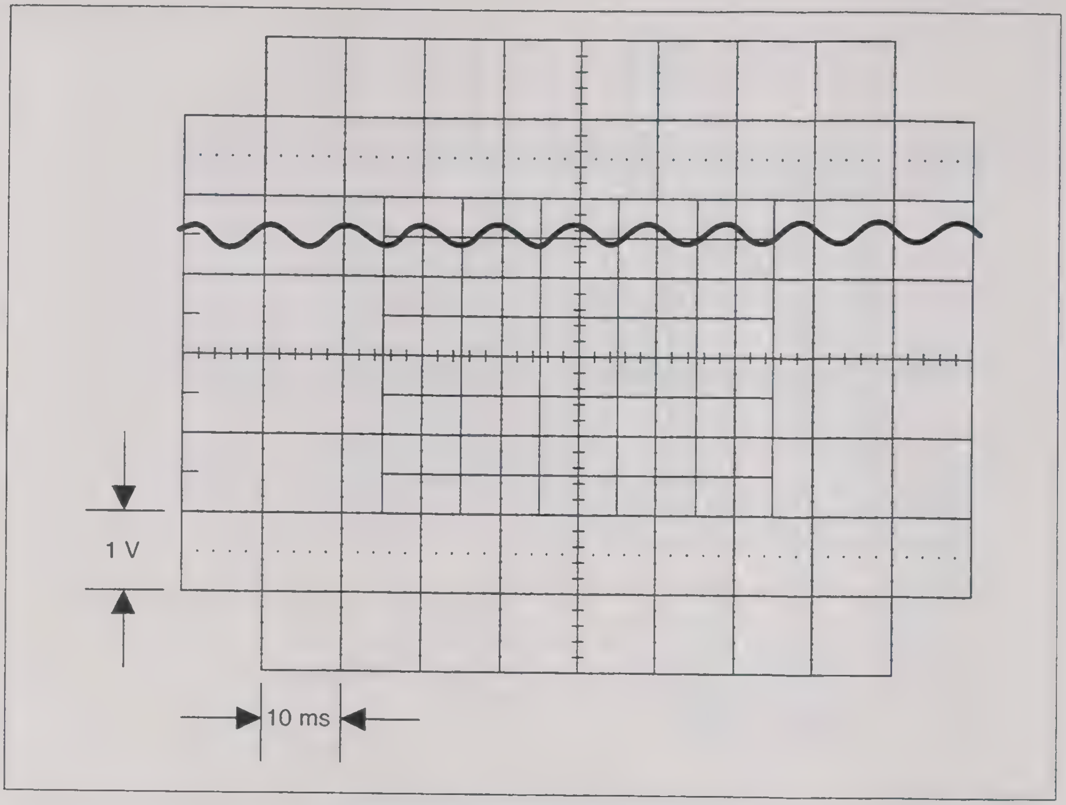

Figure 5-6. Waveform at Pin 11 of K2

12. Check the Z1 resistor network. Set the 5700A to 2 mA dc, operate. Using a DMM measure the dc voltage at pins 8 and 3 of Z1 and verify they are 1.818V dc ±0.35%. If a failure is detected, check Z1 and the HR2 hybrid.

13. Check the CURRENT/COMPLIANCE VOLTAGE MONITOR. Connect a 10Ω 1% resistor across the 5700A output and set the 5700A to 200 mA at 1 kHz, operate. Using a DMM measure the ac voltage at the OUT HI binding post and edit the current output until it measures 2.0V ac ±0.01V. Next, measure the dc voltage at TP9 and verify it is 0.238V dc ±10%. If a failure is detected, check U5, U6, and the associated components in the CURRENT/COMPLIANCE VOLTAGE MONITOR circuit.

14. Check the COMPLIANCE LIMITER. Connect a shorting jumper across the 5700A output and set the 5700A to 2 mA dc, operate. Using a DMM monitor the dc voltage at TP4. Remove the shorting jumper at the 5700A output. The voltage at TP4 should not exceed 11V ±5% before the 5700A trips to standby. If a failure is detected, check Q24, Q25, CR10, CR11, and the associated components in the Compliance Limiter Circuit.

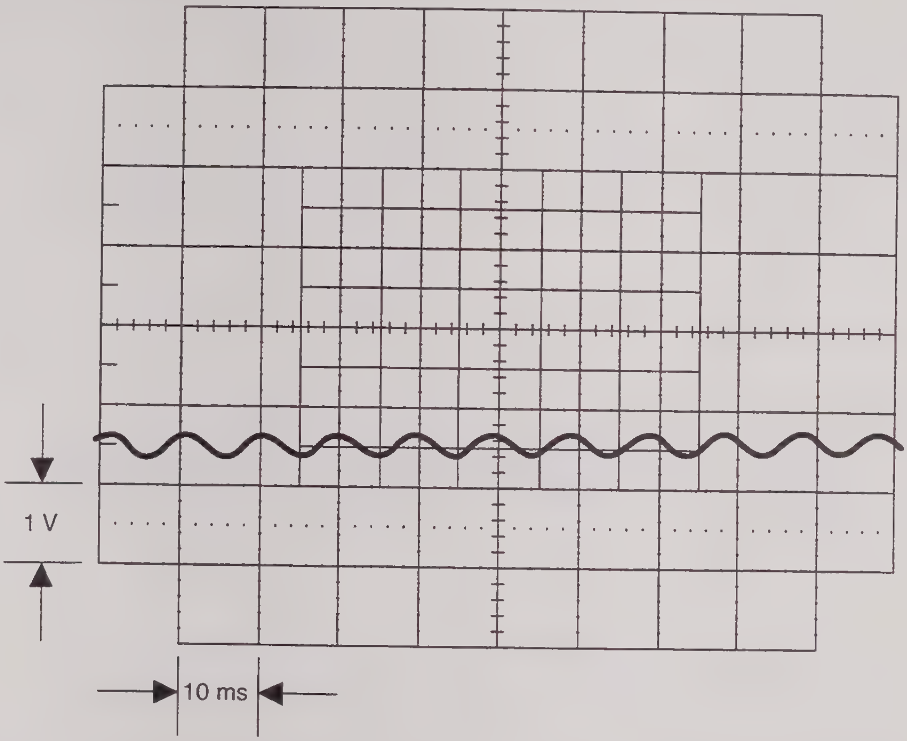

Figure 5-7. Waveform at Pin 6 of K2

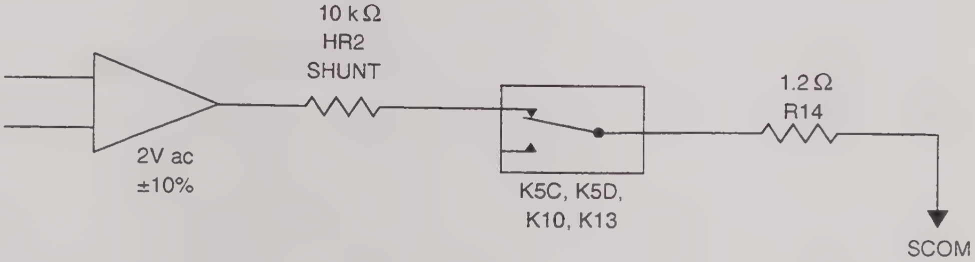

Figure 5-8. Verifying the 220 μA Range of the 220 μA/2.2 mA Amp Circuit

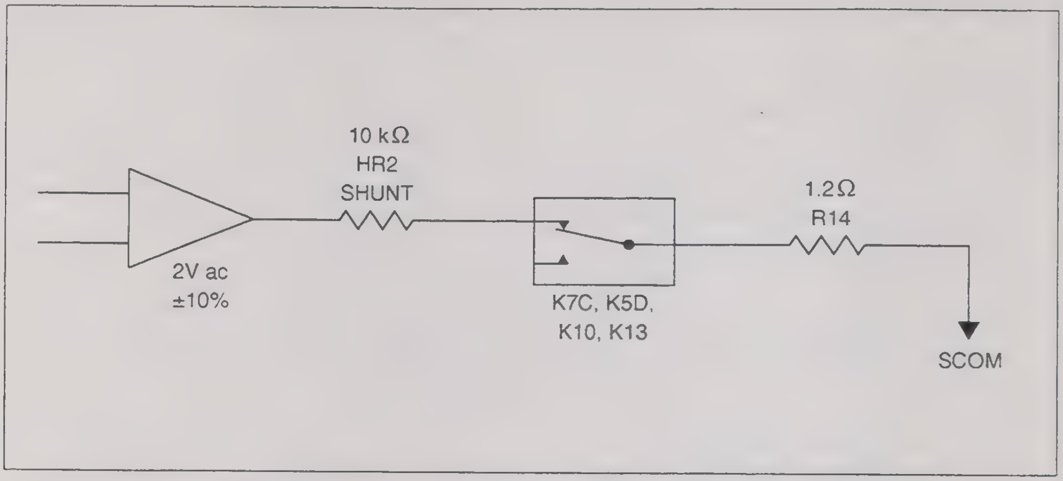

Figure 5-9. Verifying the 2.2 mA Range of the 220 μA/2.2 mA Amp Circuit

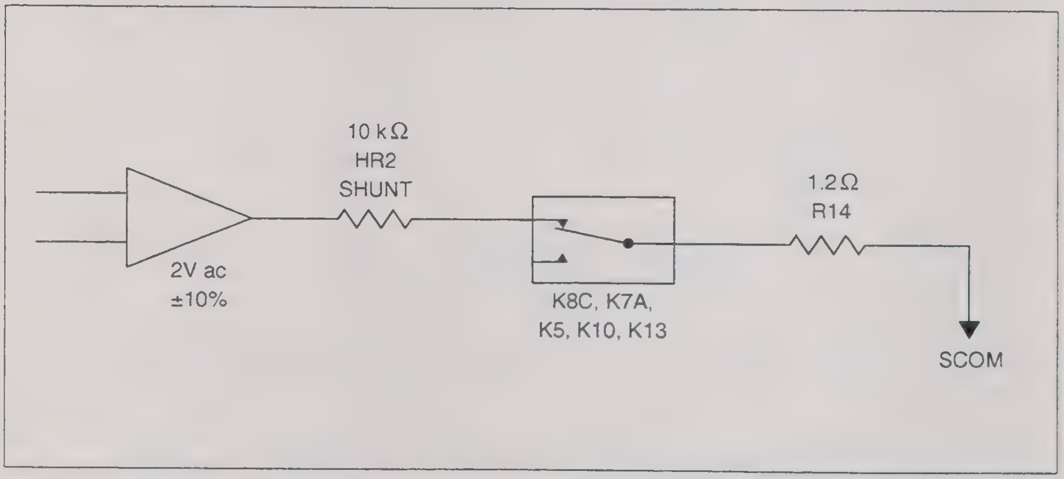

Figure 5-10. Verifying the 22 mA Range of the 22 mA/220 mA Amp Circuit

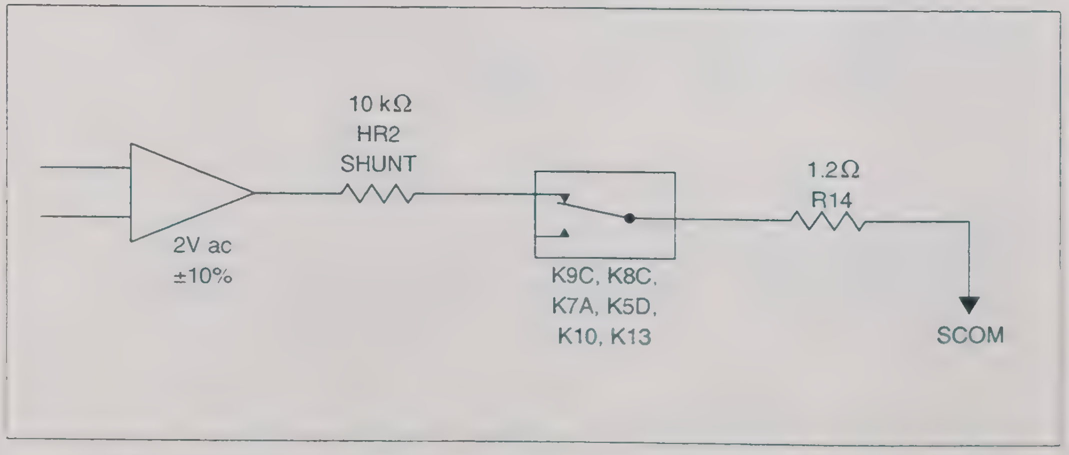

Figure 5-11. Verifying the 220 mA Range of the 22 mA/220 mA Amp Circuit

HI-RES OSCILLATOR SECTION 5-8.

Proceed as follows to troubleshoot the Hi-Res Oscillator Section of the Current/Hi-Res assembly (A7):

1. Remove the four small shields (two on each side) and place the Current/Hi-Res assembly on the analog reverse extender card. Power up the 5700A.

NOTE

All measurements are referenced to LHCOM (TP18).

2. Check the 8 MHz reference. Set the 5700A to 2V at 1 kHz, operate. Connect an oscilloscope to U13 pin 4 and verify it displays a 8 MHz signal similar to that shown in Figure 5-12. If a failure is detected, first verify that control line HI-RES ON/OFF is a logic low by measuring U15 pin 12. If not U7 is probably at fault. If this control line is correct check U13 and its associated components.

NOTE

The input CLK and CLK is a low level (400 mV p-p) signal generated by the Regulator/Guard Crossing assembly.*

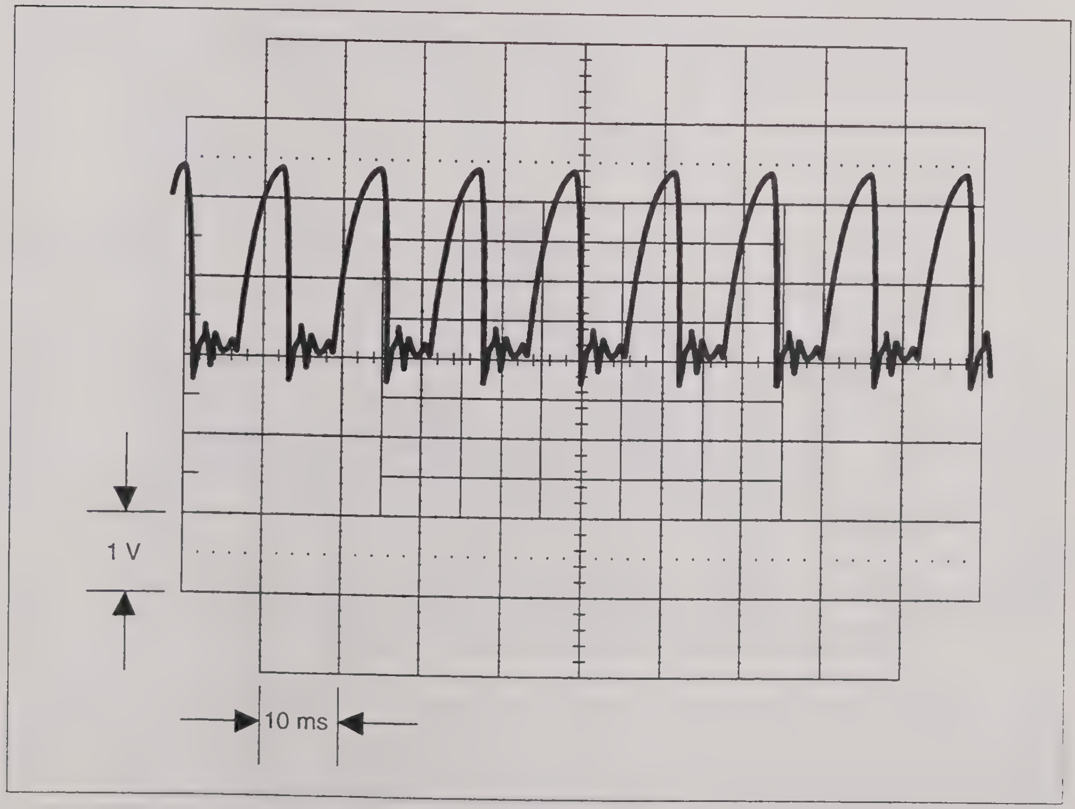

Figure 5-12. Waveform at Pin 4 of U13

3. Check the 2 MHZ REF. Set the 5700A to 2V at 1 kHz, operate. Connect an oscilloscope to TP12 and verify it displays a 2 MHz signal similar to that shown in Figure 5-13. If a failure is detected, check U14A and U14B.
4. Check the 6-12MHZ signal. Set the 5700A to 2V at 1 kHz, operate. Connect an oscilloscope to TP13 and verify it displays a 10 MHz signal similar to that shown in Figure 5-14. Also measure the frequency of this signal using a frequency counter and verify it is within 9.999 MHz to 10.001 MHz. If a failure is detected, with either test continue on as follows. If the signal and frequency are correct, skip to step 9.
5. Check VCO Supply Voltage. Set the 5700A to 2V at 1 kHz, operate. Using a DMM measure the voltage at U19 pin 8 and verify it is -5.25V ±7%. If a failure is detected, check U18A, Q15, VR3, and associated components.
6. Check the VCO circuit. Power down the 5700A, cut jumper E2 and connect an external variable dc reference (2 to 12V) to TP11 (common to TP18). Power up the 5700A and set it for 2V at 1 kHz. Connect a frequency counter to TP13. Vary the external dc reference from 2 to 12V and verify the frequency counter reading changes from approximately 6 MHz to 12 MHz.

NOTE

The voltage-to-frequency ratio is not important. It is only necessary to verify that a change in voltage causes an change in oscillation frequency. If a failure is detected check U19, CR9, and associated components in the VCO circuit.

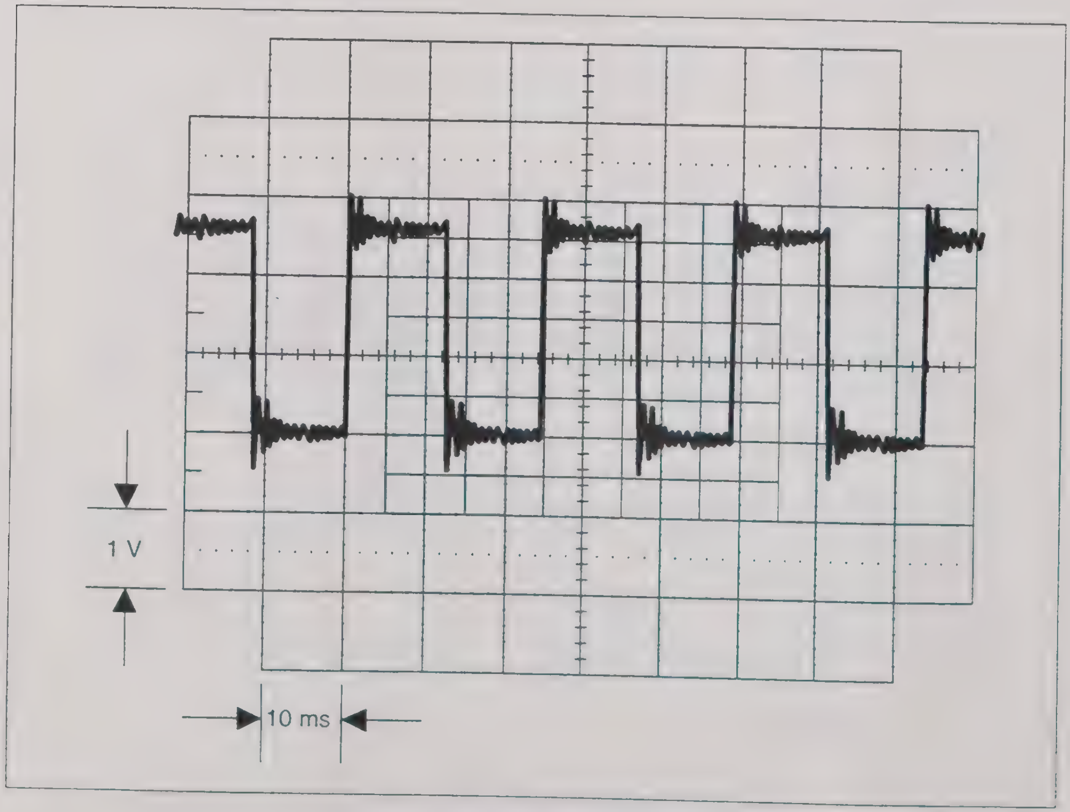

Figure 5-13. Waveform at TP12

7. Check the PHASE DET/DIVIDERS. Power down the 5700A, cut jumper E2 and connect an external variable dc reference (2 to 12V) to TP11 (common to TP18). Power up the 5700A and set it for 2V at 1 kHz. Connect a frequency counter to TP13 and adjust the external dc reference so the frequency counter reads less than 10 MHz (~9.8 MHz). Using an oscilloscope, verify that U16 pin 15 (0R) is pulsing and U16 pin 14 (0V) is a logic high. Next, adjust the external dc reference so the frequency counter reads greater than 10 MHz (~10.2 MHz). Using an oscilloscope, verify that U16 pin 14 (0V) is pulsing and U16 pin 15 (0R) is a logic high. If a failure is detected, U16 and/or its digital control is probably at fault.

8. Check the LOOP FILTER circuit. Power down the 5700A, cut jumper E2 and connect an external variable dc reference (2 to 12V) to TP11 (common to TP18). Power up the 5700A and set it for 2V at 1 kHz. Connect a frequency counter to TP13 and adjust the external dc reference so the frequency counter read less than 10 MHz (~9.8 MHz). Connect an oscilloscope to U20 pin 7 and verify it displays a positive dc voltage. Next, change the dc reference so the frequency counter reads greater than 10 MHz (~10.2 MHz). At this time U20 pin 7 should be a negative dc voltage. If a failure is detected, check U20A, U20B, and associated components in the LOOP FILTER circuit. Reconnect jumper E2 before continuing.

9. Check the 5-500K Divider. Connect a frequency counter to U21 pin 5. Set the 5700A to 2V at 1 MHz, 500 kHz, 200 kHz, 140 kHz, 100 kHz, and 50 kHz. At each output frequency verify the frequency counter displays the same as selected ±0.01%. Next, connect the frequency counter to U21 pin 9. Set the 5700A to 2V at 2 kHz, 120 Hz, and 10 Hz. At each output frequency verify the frequency counter displays the same as the selected ±0.01%. If a failure is detected, check U17 and U21.

10. Check the Output Switching. Connect an oscilloscope and frequency counter to TP16. Set the 5700A for 2V at 1 kHz, operate, and verify the oscilloscope displays a signal similar to Figure 5-15, and the frequency counter reads 1 kHz ±0.01%. Next, set the 5700A for 2V at 100 kHz and verify the frequency counter reads 100 kHz ±0.01%. If a failure is detected, check U18B,C,D, U15C, Q16, and associated components.

Troubleshooting the Switch Matrix Assembly (A8) 5-9.

Proceed as follows to troubleshoot the Switch Matrix assembly (A8):

1. The primary function of the Switch Matrix assembly is to connect the output from the various assemblies within the 5700A to the output binding posts via the Motherboard relays. All relays on the Switch Matrix assembly are latching type. These relays are latched in the set or reset position and remain in that position even after power has been removed. To troubleshoot the signal path through the Switch Matrix assembly simply set the 5700A to the function in which a problem is detected and then turn off the 5700A. Now remove the Switch Matrix from the instrument and, using an ohmmeter, check the signal path by using the relay chart in the schematic section. Check individual relays by connecting an external power supply (a typical 9V battery works well) across the set coil to place the relay in the set position or the reset coil to place the relay in the reset position.

2. Check the Motherboard relay RLY+V supply voltage. Set the 5700A to 10V dc, operate. Connect an oscilloscope to RLY+V (common to TP9), which is at the cathode of CR2, and verify it is 4.5V ±0.5V. Now verify that each time the EX SNS key is pressed the voltage at RLY+V momentarily jumps to 7.5V ±1.2V. If a failure is detected, check the control line PC5, U17, Q1, Q2, and associated components.

3. Check the Motherboard relay control lines. Motherboard relays K1- K10 are controlled by U13 on the Switch Matrix assembly. If a Motherboard relay problem is suspected, verify U13 by using the relay chart in the Switch Matrix schematic section and checking for correct logic levels at its output.

4. Check the 2.2V Range Attenuator. Set the 5700A to 2V dc, operate. Using a DMM measure the dc voltage at TP2 (common to TP8) and verify it is 2V ±6 mV.

NOTE

This 2V can be as much as ±0.12V if the DAC assembly is uncalibrated. If a failure is detected, check K1, K2, and the 5:1 divider part of the HR1 resistor network.

5. Check the 2.2V Range Amplifier. Set the 5700A to 2V dc, operate. Using a DMM measure the dc voltage at TP4 (common to TP8) and verify it is 2V ±6 mV.

NOTE

This 2V can be as much as ±0.12V if the DAC assembly is uncalibrated. If a failure is detected, check the HR1 hybrid, U19, Q4, and associated components.

6. Check the mV Dividers. Set the 5700A to 200 mV at 1 kHz, operate. Using a DMM measure the ac voltage at the cathode of CR6 (common to OUTPUT LO binding post) and verify it is 200 mV ±1%. Next, set the 5700A to 20 mV at 1 kHz operate and again measure the ac voltage at the cathode of CR6. Verify it is 20 mV ±1%. If a failure is detected, check the resistive dividers in the HR1 resistor network and the associated relays.

Troubleshooting the Ohms Cal Assembly (A9) 5-10.

Proceed as follows to troubleshoot the Ohms Cal assembly (A9):

1. The Ohms Cal assembly contains the two-wire lead drop compensation circuit, calibration circuitry, the 1Ω, 1.9Ω, and short resistance values. All relays on the Ohms Cal assembly are latching type. These relays are put in the set or reset position and they remain in that position even after power has been removed. To troubleshoot the path through the relays simply set the 5700A to the function in which problem is detected and then turn off the 5700A. The relays remain in either the set or reset position. Check individual relays by connecting an external power supply (a typical 9V battery works well) across the set coil to place the relay in the set position or the reset coil to place the relay in the reset position. Remove the rear shield from the assembly and put it up on the extender card. Power up the 5700A and continue as follows.

2. Check the 1Ω, 1.9Ω, and short. Connect a four-terminal ohmmeter (such as a Fluke Model 8505A) to the Ohms Cal assembly as follows. Connect 8505A IN HI to TP1, 8505A IN LO to TP 2, 8505A SENSE HI to TP5, 8505A SENSE LO to TP6. Set the 5700A to 1Ω, operate, EXT SNS, and verify the ohmmeter reads 1Ω ±0.1%. If a failure is detected, check relays K4, K5, K6, and the four wire-wound resistors in R41. Set the 5700A to 1.9Ω, operate, EXT SNS, and verify the ohmmeter reads 1.9Ω ±0.1%. If a failure is detected, check relays K4, K5, K30, and the two wire-wound resistors in R42. Set the 5700A to 0Ω and verify the ohmmeter reads 0Ω ±0.1%. If a failure is detected, check relays K7 and K8.

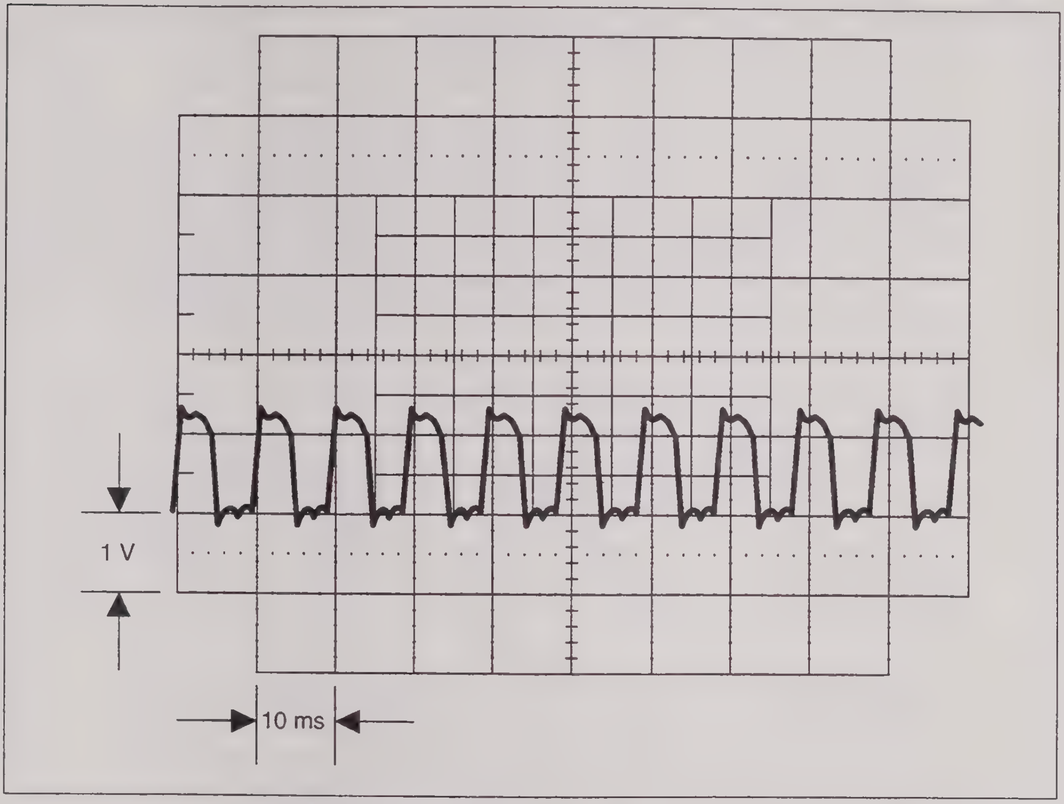

Figure 5-14. Waveform at TP13

TWO-WIRE COMPENSATION CIRCUIT 5-11.

Proceed as follows to troubleshoot the two-wire compensation circuit:

1. Check the +8A and -8A power supply for the two-wire comp. circuit. Set the 5700A to 100Ω, operate, and turn the two-wire comp on. Using a DMM measure the dc voltage at TP8 (common to TP7) and verify it is +8.2V ±5%. Next, measure the dc voltage at TP9 (common to TP7) and verify it is -8.2V ±5%. If these supply voltages are correct skip to step 2. If a failure is detected, first connect an oscilloscope to pin 16 of U6 with the scope common connected to pin 13 of U6. Set the oscilloscope to 5V/div at 10 μs/div and verify it displays a waveform similar the Figure 5-16. If a failure is detected, check U6, Q5, Q6, Control line PB7, and associated components. If this signal is correct then check T1, CR1, CR2, CR9, CR10, VR1, VR2, and associated components.
2. Set the 5700A to 100Ω, operate, INT SNS, and 2-Wire Comp ON. Connect a Fluke 8505A DMM, set to the 100Ω range, across the 5700A OUTPUT HI and OUTPUT LO binding posts. The current from the DMM should be 10 mA. Using another DMM measure the dc voltage between pins 4 and 5 of U7 and verify it is less than 4 μV. If a failure is detected check U7, U8, and associated components. Using a DMM measure the dc voltage across the 500Ω resistor in Z2 by connecting the DMM HI to TP18 and the DMM LO to TP17. Note this voltage which should be around 5.0V. Next, measure the voltage across the 1 kΩ resistor in Z2 by connecting the DMM HI to TP16 and the DMM LO to TP6. The voltage should be double and opposite polarity (gain = -2) of that previously measured (about -10V). If a failure is detected check U9, U10, and associated components.

Troubleshooting the Ohms Main Assembly (A10) 5-12.

Proceed as follows to troubleshoot the Ohms Main assembly (A10):

1. All of the fixed values of resistance, available from the 5700A, reside on the Ohms Main assembly except the 1.9Ω, 1.0Ω, and short. The fixed values of resistance from 10Ω to 100 MΩ are connected to the 5700A output binding posts through relays on the Ohms Main, Ohms Cal, and Motherboard assemblies. The Ohms Main assembly is checked by verifying each fixed value of resistance and the relay path to INT OUT HI, INT SENSE HI, OHMS OUT LO, and OHMS SENSE LO. Place the Ohms Main assembly on the extender card, power up the 5700A, and continue as follows.

2. Connect a four-terminal ohmmeter (such as the Fluke Model 8505A) to the Ohms Main assembly as follows. Connect 8505A IN HI to TP4, 8505A IN LO to TP3, 8505A SENSE HI to TP5, and 8505A SENSE LO to TP2. Set the 5700A to 10Ω, operate, EXT SNS and verify the ohmmeter reads 10Ω ±0.07%. If a failure is detected, turn off the 5700A and remove the Ohms Main assembly from the extender card. Use the schematic and the relay chart to check the connection from the test points to the 10Ω resistance.

NOTE

The connection from the test points to the resistance values is through latching type relays for all resistances except 10M, 19M, and 100 MΩ values. These relays are put in the set or reset position and remain in that position even after power has been removed. To troubleshoot the path through the relays, simply set the 5700A to the function in which a problem is detected and then turn off the 5700A. The relays remain in either the set or reset position. Check individual relays by connecting an external power supply (a typical 9V battery works well) across the set coil to place the relay in the set position or the reset coil to place the relay in the reset position.

3. Repeat step 2 for the resistances in Table 5-2 and verify they are within the specified tolerance.

4. Check the 100 MΩ resistance. Set up the ohmmeter for a two wire resistance measurement and connect IN HI to TP4 and IN LO to TP3. Set the 5700A to 100 MΩ, operate, INT SNS, and verify the ohmmeter reads 100 MΩ ±5.0%. If a failure is detected, check relay K5 and 90 MΩ resistor in R1.

Troubleshooting the DAC Assembly (A11) 5-13.

Proceed as follows to troubleshoot the DAC assembly (A11):

1. Remove the front and back shields and place the DAC assembly on the extender card. Power up the 5700A.

2. Check the 13V reference. Connect DMM to TP2 (common to TP3). The voltage should be between +13 and +14V and very stable. (Some drift may be seen while the assembly is warming up.) If the 13V reference is faulty, check the power supply voltages to the HR5 Reference Hybrid. If all the supplies are correct, the HR5 Reference Hybrid is probably at fault.

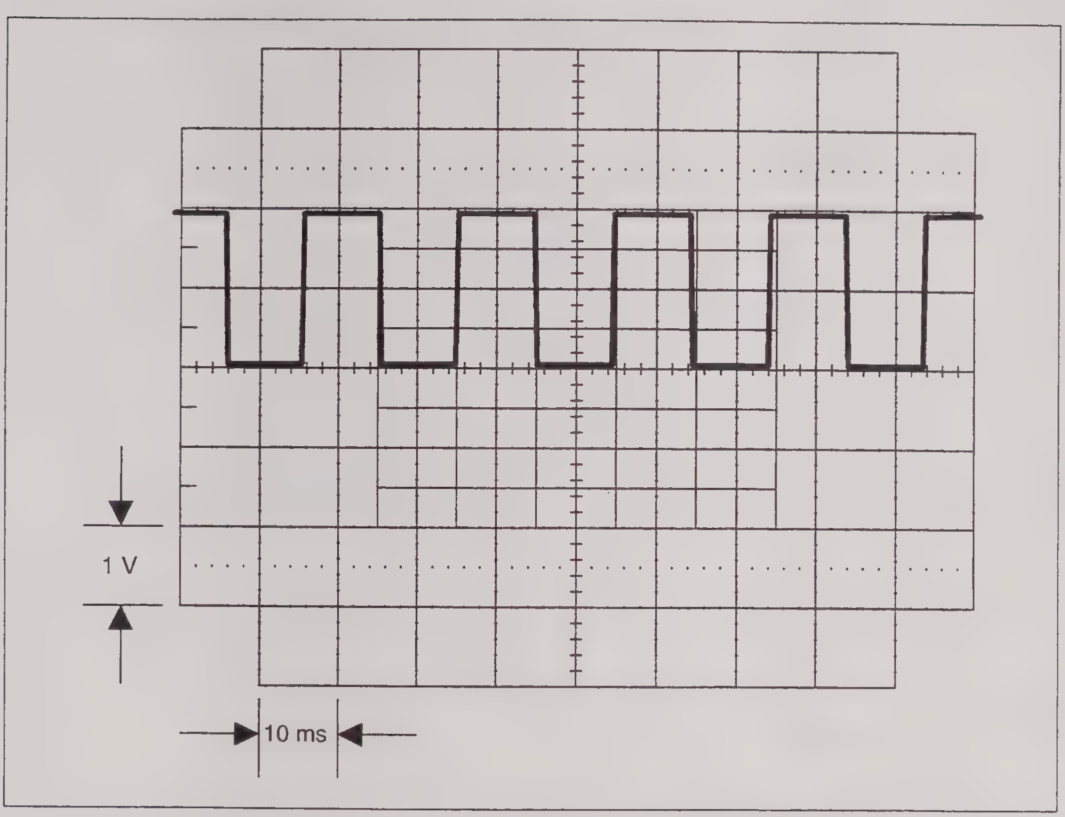

Figure 5-15. Waveform at TP16

3. Check CH1 SHUNT. Connect an oscilloscope probe to TP6 (with common connected to TP3). Set the oscilloscope to 2V/div at 2 ms/div and verify it displays pulses as shown in Figure 5-17. If the displayed signal is incorrect, skip to Duty Cycle Control Circuit.

4. Check CH1 SERIES B. Connect an oscilloscope to TP4 (common to TP3). Set the oscilloscope to 10V/div at 2 ms/div and verify it displays pulses as shown in Figure 5-18. Next, set the 5700A to 6.5V dc, operate. Verify the oscilloscope displays pulses with approximately 50% duty cycle as shown in Figure 5-19. If either of these displayed signals are incorrect, skip to Duty Cycle Control Circuit.

5. Check CH2 FILTER INPUT. Connect an oscilloscope probe to TP7 (common to TP3). Set the 5700A to 6.5V dc, operate. Set the oscilloscope to 2V/div at 2 ms/div. Verify the oscilloscope displays pulses similar to those shown in Figure 5-20.

NOTE

The duty cycle may differ from this figure. Using the 5700A edit knob vary the second LSD of the 5700A output display and verify the duty cycle of the signal at TP7 changes. If either of these displayed signals are incorrect, skip to Duty Cycle Control Circuit.

6. Check the SERIES LINEARITY CONTROL CIRCUIT. Using a DMM measure the voltage at U38 pin 6 (common to TP3). The voltage should be +23.0 to +26.4V. If this voltage is incorrect, check U38 and Z2.

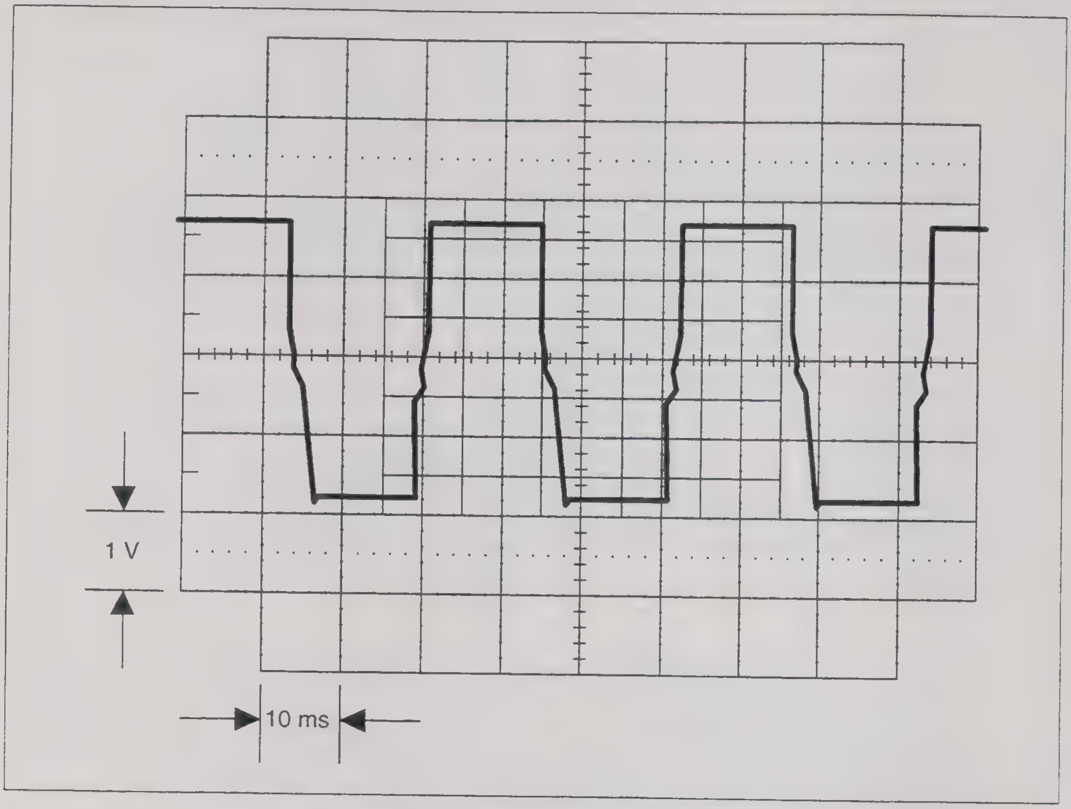

Figure 5-16. Waveform at Pin 13 of U6

Table 5-2. Ohms Main Resistance Tolerance

RESISTANCE	TOLERANCE
19Ω	±0.07%
100Ω	±0.03%
190Ω	±0.03%
1 kΩ	±0.03%
1.9 kΩ	±0.03%

7. Check the NEG. OFFSET CIRCUIT. Using a DMM measure the voltage at U2 pin 1 (common to TP3). The voltage should be -13 to -14V which is the reference voltage inverted. If this voltage is incorrect, check U2A and part of the HR6 resistor network.

8. Connect an oscilloscope to TP5 (common to TP3) and Set the 5700A to 6.5V dc, operate. Set the oscilloscope to 5V/div at 2 ms/div and verify the signal is similar to that shown in Figure 5-21. If this signal is incorrect, check Q4, Q5, Q6, and Q7.

9. Check the FILTER INPUT. Set the 5700A to 6.5V dc, operate. Measure the voltage with a DMM at TP1 (common to TP3 on the main board) on the DAC Filter SIP assembly (A11A1). It should be a nominal +6.5V dc (±0.1V for an uncalibrated instrument), free of distortion, and stable. If a failure is detected, check the DAC Filter SIP assembly.

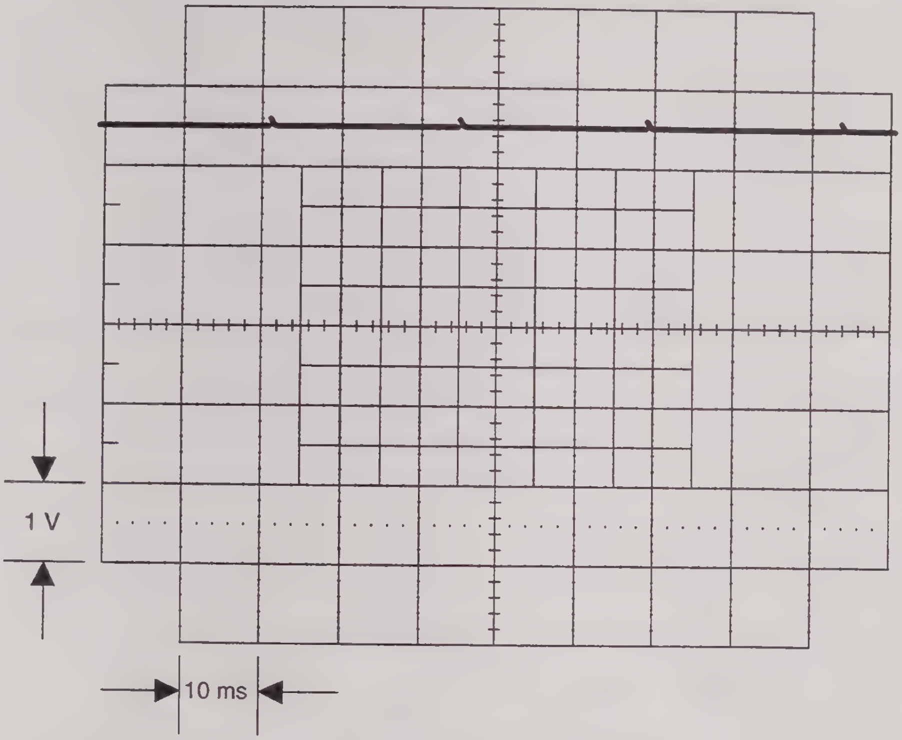

Figure 5-17. Waveform at TP6

10. Check the DC AMP HYBRID. Set the 5700A to 10V dc, operate. Measure the voltage with a DMM at pin 18 (common to TP3) of the HR6 DC AMP HYBRID. It should be a nominal +10V dc (±0.25V for an uncalibrated instrument), free of distortion, and stable. If a failure is detected, check the HR6 Hybrid assembly and its heater control circuit.

11. Check the OUTPUT BUFFER circuit. Set the 5700A to 10V dc, operate. Measure the voltage with a DMM at L10 (common to TP3). It should be a nominal +10V dc (±0.25V for an uncalibrated instrument), free of distortion, and stable. If a failure is detected, check U5 and its associated components.

12. Check the DAC OUTPUT SWITCHING. Set the 5700A to 10V dc, operate. Measure the DAC output voltage with a DMM a TP8 (common to TP12). It should be a nominal +10V dc (±0.25V for an uncalibrated instrument). Set the 5700A to -10V dc, operate. Again check the voltage at TP8 (common to TP12). It should be a nominal -10V dc (±0.25V for an uncalibrated instrument). If either of these voltages are incorrect, check the output switching relays K1, K2, K8, and their drive circuitry.

13. Check the RANGE SELECT control line. Set the 5700A to 10V dc, operate. Using a DMM measure the RANGE SELECT control line at U37 pin 7 (common to TP3). It should be -16 to -19V dc. Set the 5700A to 20V operate and again measure the RANGE SELECT control line for +4.0V to +11V. If either of these measurements are incorrect, check U37, U8B, U8C, and their associated components.

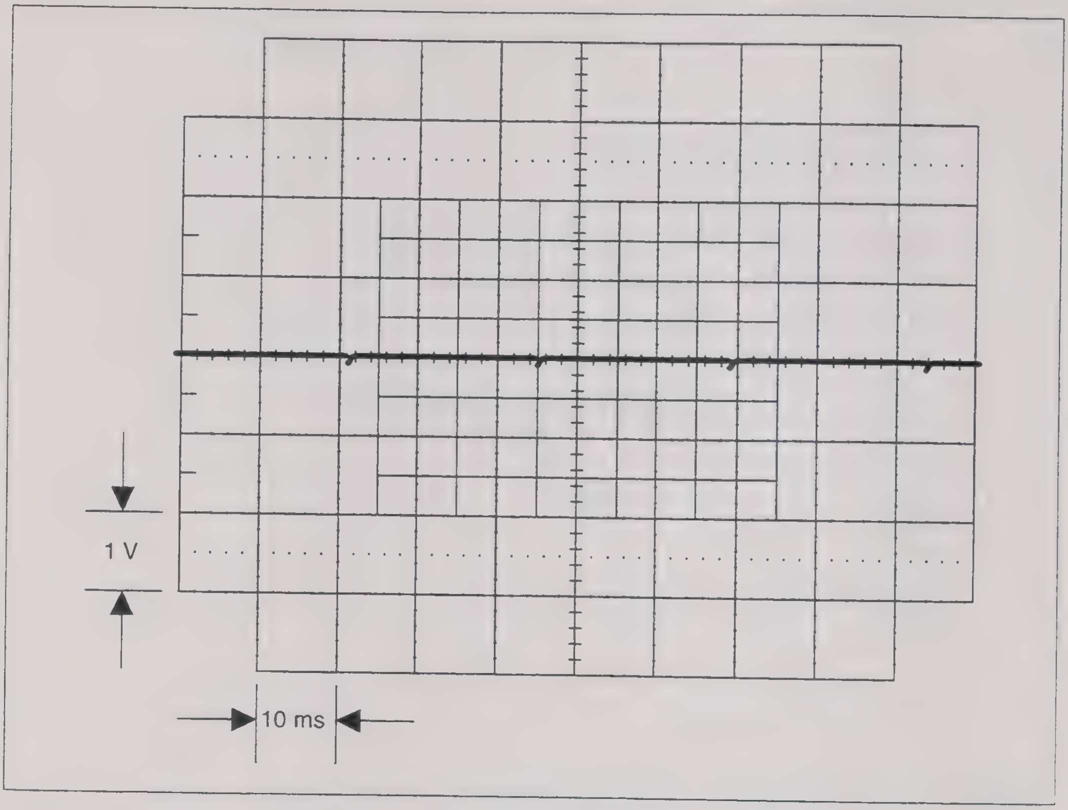

Figure 5-18. Waveform at TP4, 5700A Set to 0V

14. Check the DAC 20V Range. Set the 5700A to 20V dc, operate. Using a DMM measure the DAC output voltage at TP8 (common to TP3). It should be a nominal 20V dc (±0.5V for an uncalibrated instrument). If a failure is detected, check Q14, Q15, Q18, Q19, Q20, Q21, and their associated components.

15. Check the SHUNT LINEARITY CONTROL CIRCUIT. Set the 5700A to 10V dc, operate. Measure the voltage with a DMM at U2 pin 7 (common to TP3). It should be a nominal -10V dc (±0.35V for an uncalibrated instrument and ±0.1V for a calibrated instrument). Set the 5700A to 20V dc, operate, and again measure the voltage at U2B pin 7. It should still be the nominal -10V dc within the same tolerance. If either of these voltages are incorrect, check U2B, Q22, and the associated 80 kΩ resistors in the HR6 Hybrid assembly.

16. Check the SENSE HI CURRENT CANCELLATION CIRCUIT. Set the 5700A to 10V dc, operate. Measure the voltage with a DMM at TP8 (common to TP3) and note the reading. Next, measure the output high binding post of the 5700A (common to TP3). It should be the same as the noted reading ±10 ppm. If a failure is detected, check U1A and associated components in the Sense Hi Current Cancellation Circuit.

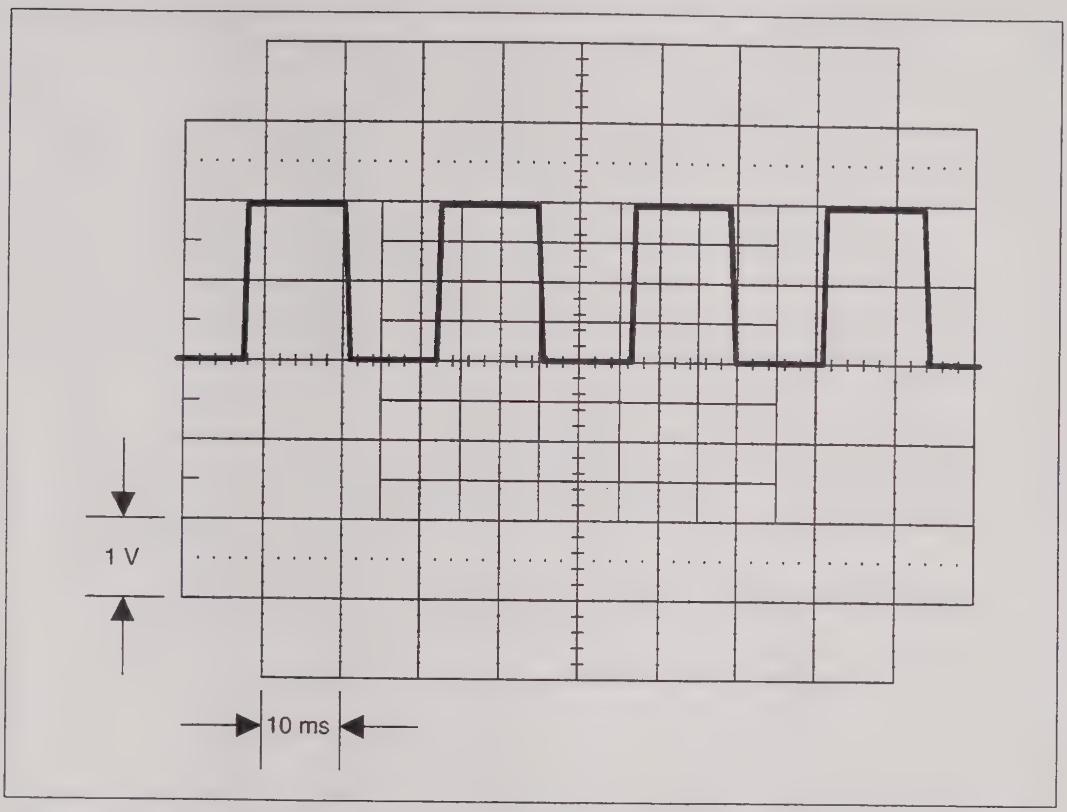

Figure 5-19. Waveform at TP4, 5700A Set to 6.5V

DUTY-CYCLE CONTROL CIRCUIT 5-14.

Proceed as follows to troubleshoot the duty-cycle control circuit:

1. Check the 8 MHz clock for U6. Connect an oscilloscope to U6 pin 10 (common to TP1). Set the oscilloscope for 2V/div at 100 ns/div and verify the display shows an 8 MHz clock similar to that shown in Figure 5-22. If a failure is detected, check U7 and its associated components. The input signal (CLK and CLK*) to U7 is a low-level (400 mV p-p) 8 MHz clock generated by the Regulator/Guard Crossing assembly.
2. Check OUT1 from U6. Connect an oscilloscope to U6 pin 16 (common to TP1). Set the 5700A to 6.5V dc, operate, and set the oscilloscope to 2V/div at 2 ms/div. The oscilloscope should display a TTL-level square wave with approximately a 50% duty cycle. If a failure is detected, check U6 and all its control lines.
3. Check OUT2 from U6. Connect an oscilloscope to U6 pin 20 (common to TP1). Set the 5700A to 6.5V dc, operate, and the oscilloscope to 2V/div at 2 ms/div. The oscilloscope should display a TTL level square wave. If a failure is detected, U6 is probably at fault.
4. Check CH1 FLOATING. Connect an oscilloscope to U13 pin 6 (common to TP1). Set the 5700A to 6.5V dc, operate, and the oscilloscope to 2V/div at 2 ms/div. The oscilloscope should display a TTL level signal similar to Figure 5-23. If a failure is detected, check U13 and its associated components.
5. Check the Clock to U14. Connect an oscilloscope to U10 pin 4 (common = TP3) and set it for 2V/div at 100 ns/div. Verify it displays a 8 MHz clock similar to Figure 5-24. If a failure is detected, check U10 and its associated components.

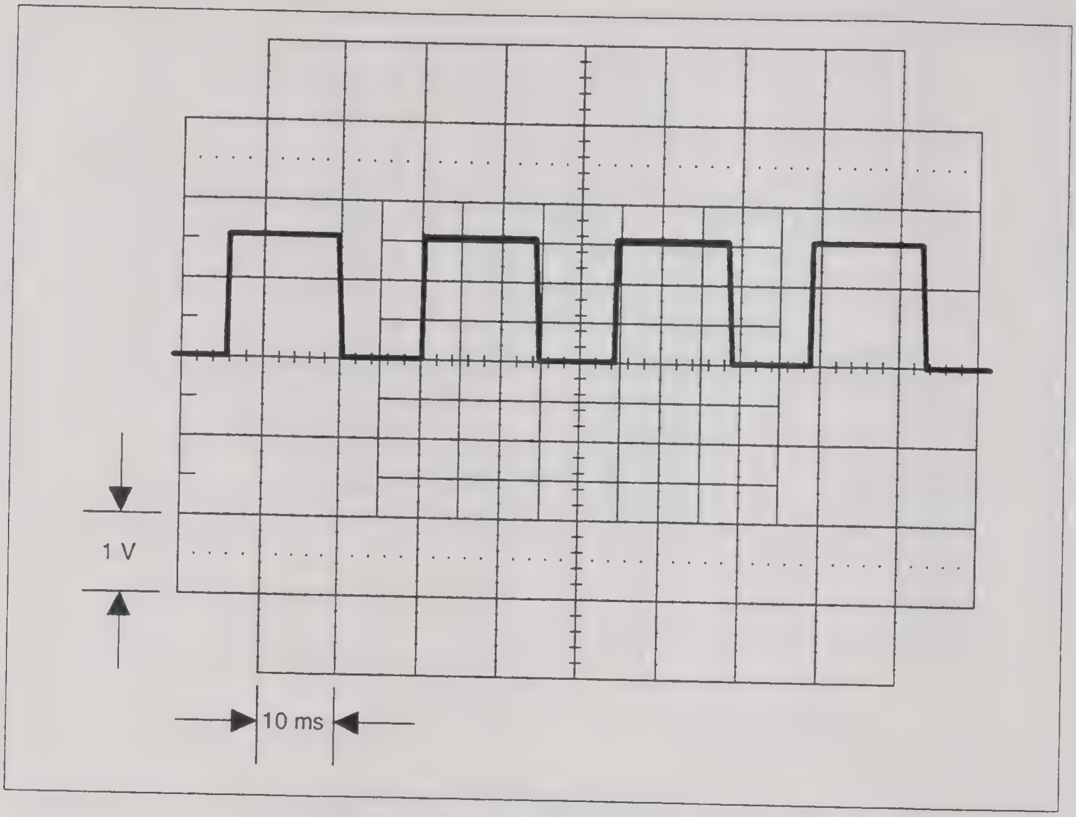

Figure 5-20. Waveform at TP7

6. Check the Watchdog Clock. Connect an oscilloscope to U14 pin 8 (common to TP3) and verify it displays a TTL level 4 MHz clock. If a failure is detected, check U14.

7. Check the Watchdog Timer. Connect an oscilloscope to U15 pin 13 (common to TP3) and verify it displays a constant logic high. If a failure is detected, check U15 and associated components.

8. Check the Q1 and Q1* output of U14. Connect an oscilloscope to U14 pin 5 (common to TP3). Set the 5700A to 6.5V dc, operate, and set the oscilloscope to 2V/div at 2 ms/div. The oscilloscope should display a TTL-level square wave with approximately a 50% duty cycle. Connect the oscilloscope to pin 6 of U14 and verify it to be the compliment signal. If either signal is incorrect, U14 is probably at fault.

9. Check CH1 SHUNT. Connect an oscilloscope to TP6 (common to TP3). Set the 5700A to 6.5V dc, operate, and set the oscilloscope to 2V/div at 2 ms/div. The oscilloscope should display a signal similar to Figure 5-25. If a failure is detected, check Q35 and its associated components.

10. Check CH1 SERIES B. Connect an oscilloscope to TP4 (common to TP3). Set the 5700A to 6.5V dc, operate, and the oscilloscope to 10V/div at 2 ms/div. The oscilloscope should display a signal similar to previously shown Figure 5-19. If a failure is detected, check Q33, Q34, and their associated components.

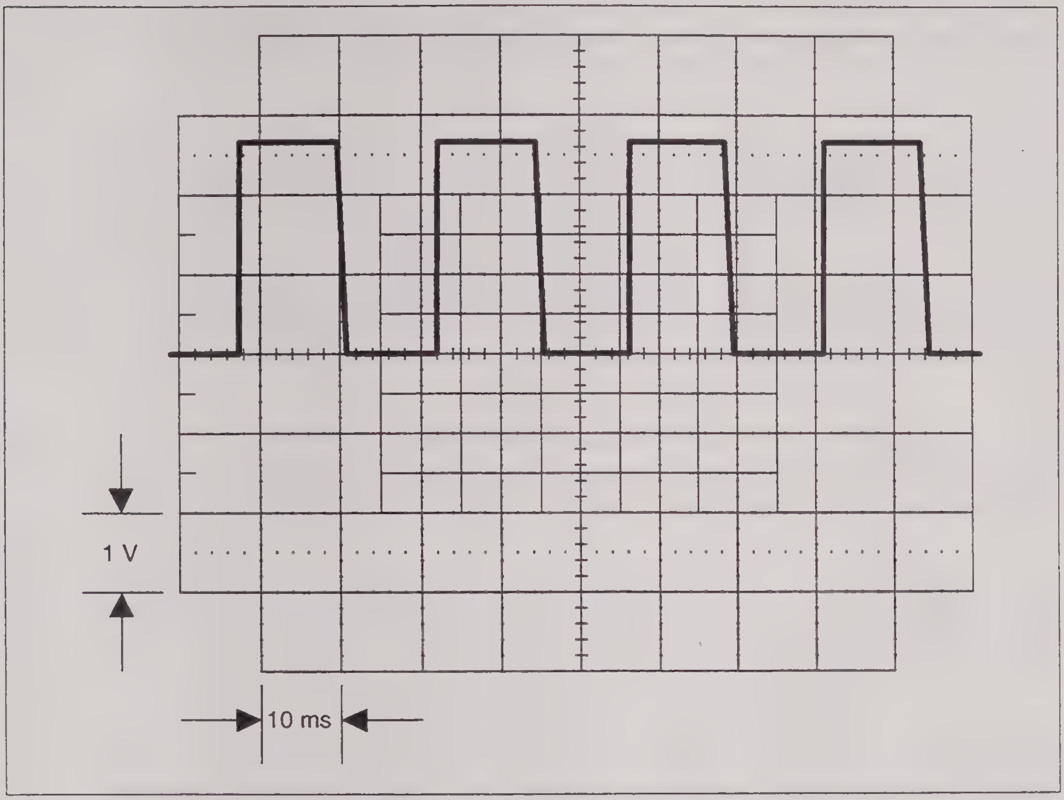

Figure 5-21. Waveform at TP5

11. Check CH2 FLOATING. Connect an oscilloscope to U12 pin 7 (common to TP3) and set it to 10V/div at 2 ms/div. Verify it displays a signal similar to Figure 5-26.

NOTE

The duty cycle may differ from Figure 5-26. At this time just verify the amplitude and a sharp rise and fall time. If a failure is detected, check U12 and its associated components.

12. Check 3V reference. Using a DMM measure the voltage at U11 pin 3 (common to TP3) for a nominal 3V dc. If this voltage is incorrect check U1B and the associated resistors on the HR5 Hybrid assembly.

13. Check CH2 FILTER INPUT. Connect an oscilloscope to TP7 (common to TP3) and set it to 2V/div at 2 ms/div. Verify it displays a signal similar to the previously shown Figure 5-20.

NOTE

The duty cycle may differ from Figure 5-20. If a failure is detected, check U11, Q30, Q31, Q32, and their associated components.

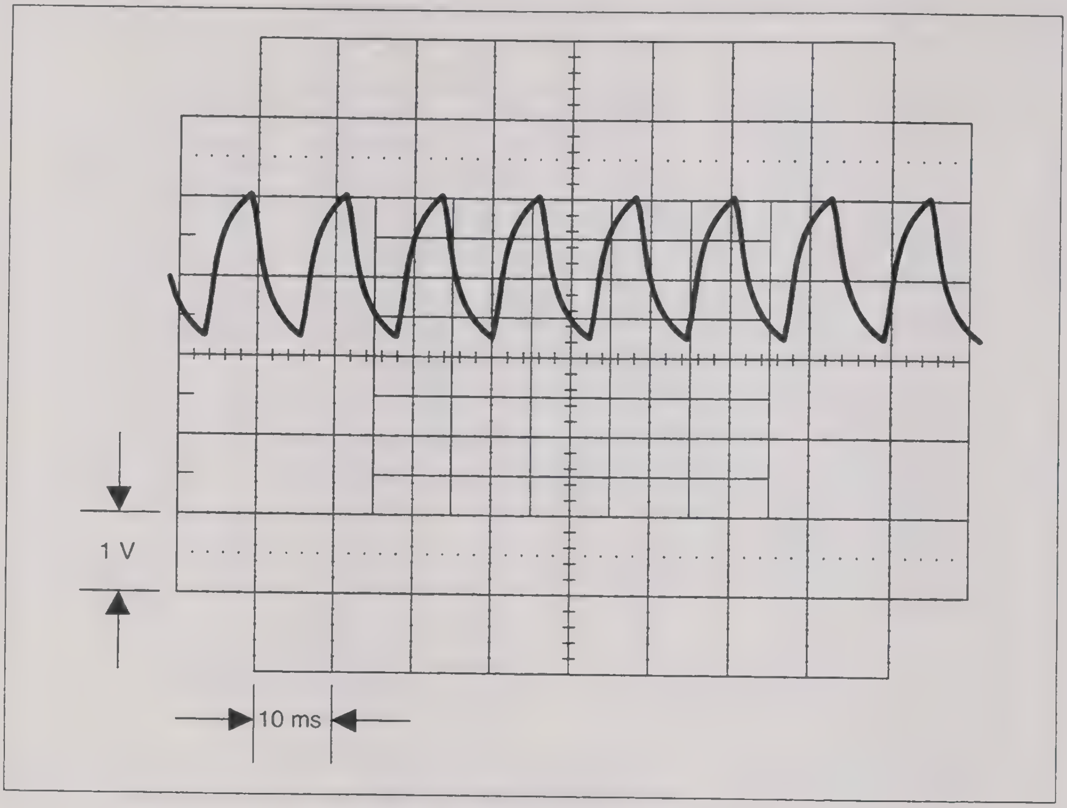

Figure 5-22. Waveform at Pin 10 of U6

ADC CIRCUIT 5-15.

Proceed as follows to troubleshoot the ADC circuit:

1. Check the ADC INPUT select circuit. Set the 5700A to 10V dc, operate. Verify that the voltage at U23 pin 7 (common to TP12) is 0.45V±7%. If this voltage is incorrect, check U23 and its control lines. At this time DAC HI DIAG is divided by R79 and R84 (0.45V) and selected by control line DAC DIAG SEL.
2. Check the ADC INPUT. Set the 5700A to 10V dc, operate. Verify that the voltage at U25 pin 22 (common to TP12) is 0.45V±7%. If this voltage is incorrect, check U24 and its associated components.
3. Check the buffered DAC LO DIAG. Set the 5700A to standby. Verify that the voltage at U22 pin 6 (common to TP1) is 0V±11 mV. If this voltage is incorrect, check U22 and associated components.
4. Check the ADC +7.5V supply. Set the 5700A to standby. Verify that the voltage at U25 pin 16 (common to TP1) is 7.5±0.5V. If this voltage is incorrect, check VR27 and R77.
5. Check the ADC -8.2V supply. Set the 5700A to standby. Verify that the voltage at U25 pin 17 (common to TP1) is -8.2±0.5V. If this voltage is incorrect, check VR28 and R94.
6. Check the BUFFERED ADC COM. Set the 5700A to standby. Verify that the voltage at U26 pin 7 (common to TP12) is 0V±600 mV. If this voltage is incorrect, check U20B, U26A, and associated components.
7. Check the ADC -6.4V Reference. Verify that the voltage at the anode of VR29 (common to TP12) is -6.4±0.2V. If this voltage is incorrect, check VR29, VR30, U20B, U26A, and associated components.

8. Check the ADC +6.4V Reference. Verify that the voltage at U27 pin 1 (common to TP12) is 6.4±0.2V. If this voltage is incorrect, check U27B and associated components.

9. Check the ADC SAMPLE/HOLD +BOOTSTRAP supply. Set the 5700A to standby. Verify that the voltage at U29 pin 7 (common to TP12) is between 5.4 and 8.2V. If this voltage is incorrect, check U29, Q56, Q57, VR31-VR34, and associated components.

10. Check the ADC SAMPLE/HOLD -BOOTSTRAP supply. Set the 5700A to standby. Verify that the voltage at U29 pin 4 (common to TP12) is between -5.4 and -8.2V. If this voltage is incorrect, check U29, Q56, Q57, VR31- VR34, and associated components.

11. Check the -INPUT of the ADC AMP. Set the 5700A to 2V at 1 kHz, operate, and measure the voltage at TP10 (common to TP12). The voltage should be a nominal 6.3V dc which is the output of the DAC. If this voltage is incorrect, check relay K5 and its drive circuit.

12. Check the +INPUT of the ADC AMP. Set the 5700A to 2V at 1 kHz, operate, and measure the voltage at TP9 (common to TP12). The voltage should be a nominal 6.3V dc which is the voltage on the RCL line. If this voltage is incorrect, check relays K6, K7, and their drive circuit.

13. Check ADC AMP gain. Set the 5700A to 2V at 1 kHz, operate. Measure the voltage at TP9 (+INPUT) with common to TP10 (-INPUT) and note the reading. Next, measure the voltage at TP11 with common to TP12 and verify that it is 11 times greater (±15 mV) than the previous noted reading. If this voltage is incorrect, check U19A, U19B, and their associated components.

14. Check the ADC INPUT select. Set the 5700A to 2V at 1 kHz, operate, and measure the voltage at U23 pin 7 (common to TP12). It should be the same as the voltage measured at TP11 in the previous step. If it is not, check U23 and the control line ADCAMP OUT SEL.

BUFFERED REFERENCE SIP ASSEMBLY (A11A2): 5-16.

Proceed as follows to troubleshoot the Buffered Reference SIP Assembly (A11A2). Set the 5700A to the power-up default state for these tests:

1. Check the buffered 6.5V reference. Measure the voltage at TP1 on the Buffered Reference SIP assembly (common to TP1 on the main board). This voltage should be between 6.5 and 7.0V dc and very stable. If this voltage is incorrect, check U1A, U2A, Q3, and Q4 on the Buffered Reference SIP assembly (A11-A2).

2. Check the buffered 13V reference. Measure the voltage at TP2 on the Buffered Reference SIP assembly (common to TP1 on the main). This voltage should be between 13 and 14V dc and very stable. If this voltage is incorrect, check U1B, U2B, Q10, and Q11 on the Buffered Reference SIP assembly (A11-A2).

Troubleshooting the Oscillator Control Assembly (A12) 5-17.

The first part of this troubleshooting procedure (steps 1 through 7) checks the averaging converter. The second part (steps 8 through 10) checks the AC/DC transfer circuit.

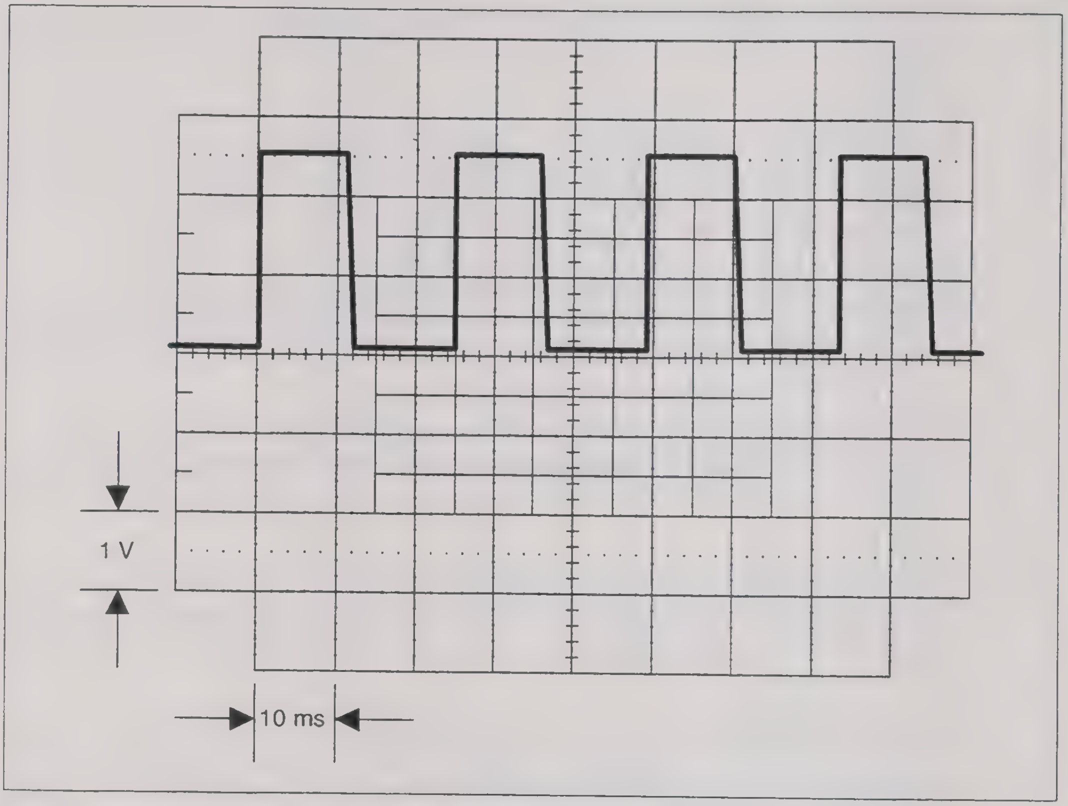

Figure 5-23. Waveform at Pin 6 of U13

NOTE

During normal operation of the 5700A, internal software monitors the output and makes corrections or trips the instrument to standby. This internal monitoring can cause problems when attempting to troubleshoot the Oscillator Control assembly. Defeat the monitoring by connecting a jumper from TP9 to TP10 on the DAC assembly and another jumper connecting SDL (P501 pin 11A/11C) to SCOM (P502 pin 32A/32C) on the Oscillator Control assembly.

After defeating the monitoring circuit, remove the rear shield and place the Oscillator Control assembly on the extender card. Power up the 5700A and proceed as follows to troubleshoot the Oscillator Control assembly (A12):

1. Check inputs to the Oscillator Control assembly. Set the 5700A to 1.0V at 1 kHz, operate. On this Oscillator Control assembly measure the DAC assembly output voltage at TP3 (common to TP2) for 3.16V dc ±50 mV. Also measure OSC SENSE HI at TP1 for a nominal 1.0V ac ±50 mV. If these voltages are incorrect, check the input switching relay K1 and its drive circuitry.

2. Check the CURRENT CANCELLATION CIRCUITS. Set the 5700A to 1.0V at 1 kHz, operate. Measure the ac voltage at TP1 (common to TP2) and note the reading. Move the DMM test leads to the output of the 5700A. The measured ac voltage should be the same as noted ±10 ppm. If a failure is detected, check the CURRENT CANCELLATION CIRCUITS as outlined on the schematic.

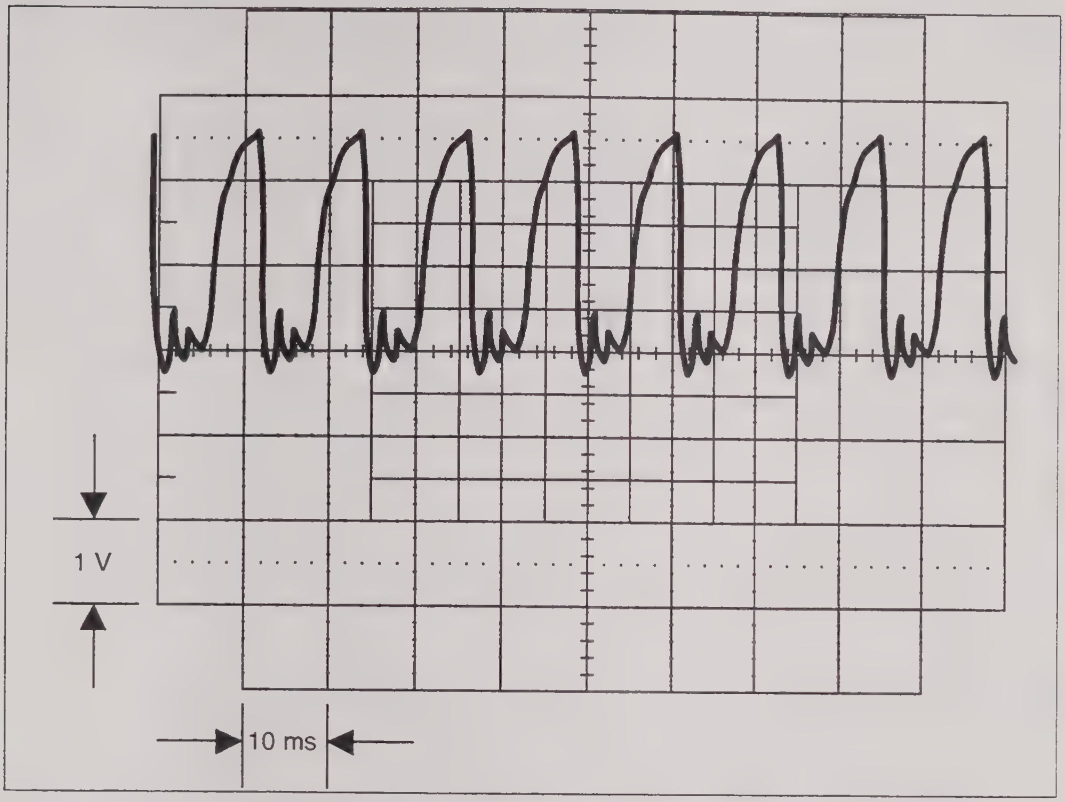

Figure 5-24. Waveform at Pin 4 of U10

3. Check the BUFFER AMP circuit. Set the 5700A to 1.0V at 1 kHz, operate, and measure the BUFFER AMP output at TP4 (common to TP2). It should be the same voltage as on TP1 ±1%, with <50 mV of offset. Change the 5700A output to 10.0V and again measure the BUFFER AMP output. The voltage should remain the same ±1%. If these voltages are incorrect, check the input attenuator (Z2 and K3) and the BUFFER AMP (U3 and associated components).
4. Check the RECTIFYING AMP circuit. Connect an oscilloscope to the anode of CR4 (common to TP2). Set the oscilloscope to 2V/div. and 200 μs/div. The oscilloscope should display a signal as in Figure 5-27. If the signal is incorrect, check U5, U7, Q3, Q4, CR4, CR5, and associated components in the RECTIFYING AMP circuit.
5. Check the 15 BIT DAC circuit. Set the 5700A to 1.0V at 1 kHz, operate. Connect a DMM to U26 pin 6 (common to TP2) which is 14 BIT DAC OUT. It should be stable dc voltage between 0 and -3.16V. If this voltage is incorrect, check U10, U26, Q19, and associated components in the 15 BIT DAC circuit.
6. Check the ERROR INTEGRATOR output. Set the 5700A to 1.0V at 1 kHz, operate. Connect an oscilloscope to U11 pin 6 (common to TP2) which is ERROR INT. OUT. Set the oscilloscope to 500 mV/div and 200 us/div. The oscilloscope should display a ripple similar to Figure 5-28. The dc level of this signal can be between -5V and +5V. If an error is detected, check U11 and associated components.
7. Check the OSC CONT signal. Set the 5700A to 1.0V at 1 kHz, operate. Connect the oscilloscope to TP5 (common to TP2). OSC CONT should be a dc voltage between +5 and -5V, free of distortion. If this voltage is incorrect, check U8, U9B, and associated components in the 3 POLE FILTER circuit and buffer amp U9A.

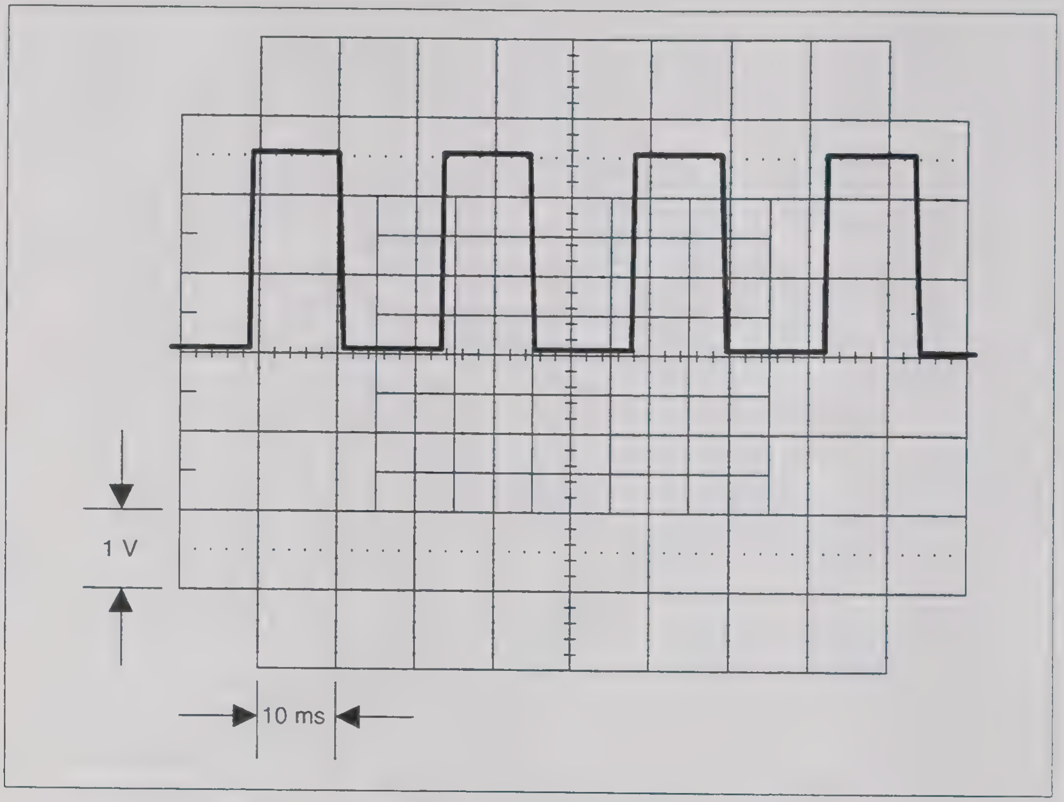

Figure 5-25. Waveform at TP6

8. Check the DC SENSE BUFFER and the AC SENSE BUFFER. Set the 5700A to 1.0V at 1 kHz, operate. Connect an oscilloscope to TP6 (common to TP2) which is the input to the AC/DC sensor. The oscilloscope display should be switching between Figure 5-29, which is the output of the DC SENSE BUFFER circuit and Figure 5-30, which is the output of the AC SENSE BUFFER circuit. If either of these signals is incorrect, check the appropriate SENSE BUFFER circuit as outlined on the schematic. If these voltages are correct, set the 5700A to 10.0V at 1 kHz, operate, and verify the ac amplitude from the AC SENSE BUFFER remains the same. If a failure is detected, check relay K4 and resistor Z3 in the AC SENSE BUFFER circuit.

NOTE

Before proceeding remove the jumper connecting SDL to SCOM on this Oscillator Control assembly and the jumper connecting TP9 to TP10 on the DAC assembly.

9. Check the AC/DC THERMAL SENSOR & SQUARE ROOT AMP. Set the 5700A to 1.0V at 1 kHz, operate. Connect a DMM to TP7 (common to TP2) which is the output of the Fluke RMS Sensor. The DMM should read 3.16V dc ±160 mV. If this voltage is incorrect, check U14, U15, U17, and associated components.
10. Check the RCL ANALOG SWITCHING circuit. Set the 5700A to 1.0V at 1 kHz, operate. Connect a DMM to TP8 (common to TP2) which is the RCL line. The DMM should read the same voltage at TP7 in the previous step. If this voltage is incorrect, check U19A, K6, and their drive circuitry. Set the 5700A to 5V at 1 kHz, operate. The DMM connect to TP8 should read 1.58V ±160 mV. If this voltage is incorrect, check U31, U19B, K7, and their appropriate drive circuit.

Troubleshooting the Oscillator Output Assembly (A13) 5-18.

NOTE

During normal 5700A operation, internal software monitors the output and makes corrections or trips the instrument to standby. This internal monitoring can cause problems when attempting to troubleshoot the Oscillator Output assembly. Defeat the monitoring by connecting a jumper from TP9 to TP10 on the DAC assembly and another jumper connecting SDL (P511 pin 11A/11C) to SCOM (TP1) on the Oscillator Output assembly.

After defeating software monitoring, Remove the front air duct and rear shield from the Oscillator Output assembly. Place the assembly on the extender card, and proceed as follows to troubleshoot the Oscillator Output Assembly (A13):

1. Turn on the 5700A.
2. Check for oscillation at INT OSC OUT. Connect an oscilloscope probe to TP3 (common to TP1). A 100 Hz sine wave at 5.12V rms ±0.25V should be present. If no oscillation is present proceed with step 3; otherwise skip to step 4.
3. Unsolder and lift up one end of feedback resistor R6. Jumper the input to the SUMMING AMPLIFIER (the node of R1, R6, and U3 pin 5) to the +5S supply. All four amplifiers in this oscillator section are inverting amplifiers. With a positive voltage at the input, check for the following:
    - TP5: negative voltage
    - TP4: positive voltage
    - TP3: negative voltage
    - Pin 6 of U8: negative voltage
4. Next, jumper the input of the SUMMING AMPLIFIER to the -5S supply and check the following:
    - TP5: positive voltage
    - TP4: negative voltage
    - TP3: positive voltage
    - Pin 6 of U8: positive voltage
5. Repair any amplifier circuits which are not properly inverting. Reinstall feedback resistor R6. If the 100 Hz oscillation is still not present, check rectifying diodes CR1-CR4 and the summing resistors in Z6. The output of Z6 is summed with the -12V reference by R42 and R43. Check the ERROR INTEGRATOR circuit by making sure op amp U18 is inverting. If it is not, check U18 and its associated circuitry. If U18 is inverting properly, the problem is probably due to the MULTIPLIER U16 or its associated components.
6. Check INT OSC OUT for correct oscillation at each frequency range. Connect an oscilloscope to TP3 (common to TP1). Set the 5700A for 2V at 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz. If any of the frequency ranges are bad (i.e., no oscillation or oscillation at the wrong frequency range or wrong voltage) check relays K1, K2, K3, their associated drive circuits, and the amplifier feedback capacitors that these relays select.

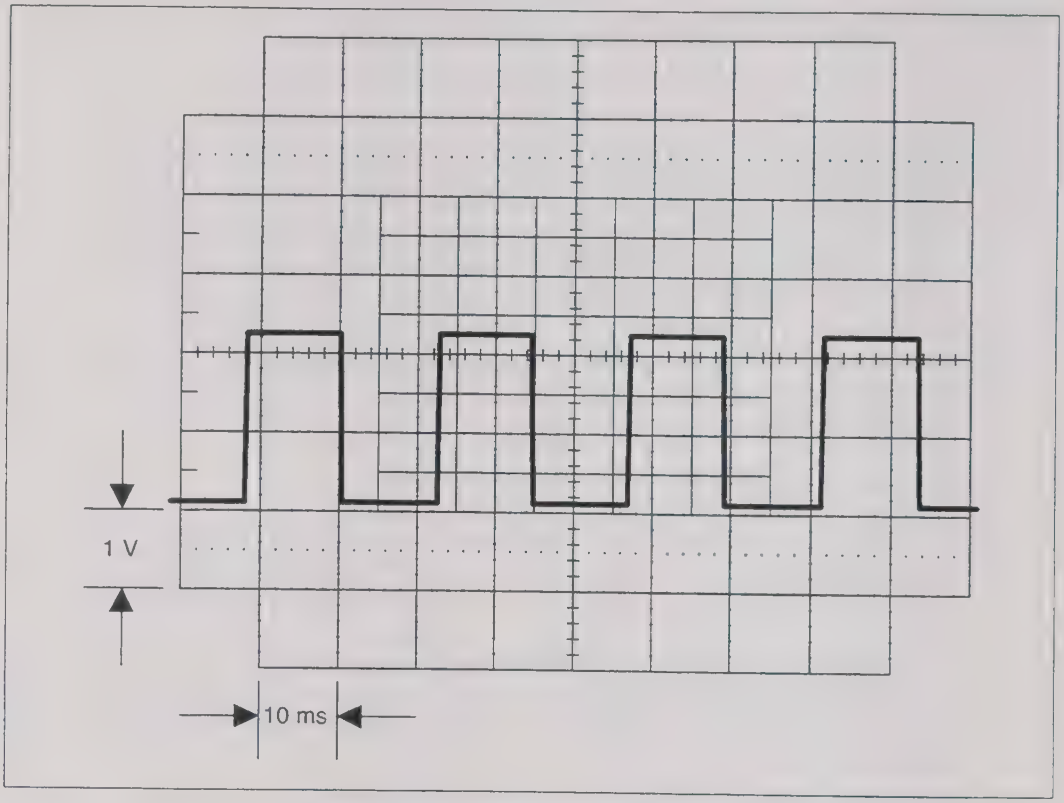

Figure 5-26. Waveform at Pin 7 of U12

7. Check INT OSC OUT for correct frequency oscillation within a frequency range. Connect a frequency counter to TP3 (common to TP1). Set the 5700A for 2V at 5 kHz, operate. Check each frequency digit using the edit knob. If a failure is detected, check the FREQ DATA bus D1-D7 (D0 is only used during external phase lock) by editing the frequency and seeing that each bit toggles between +5V and ground. If each bit of the FREQ DATA bus is toggling properly the problem is probably due to resistive DACs U5 and/or U7. If a failure with the FREQ DATA bus is detected, U32 is probably at fault.

8. Check the 2.2V range output of the Oscillator. Set the 5700A for 2V at 1 kHz, operate. Measure the output at TP2 (common to TP1) for an undistorted sine wave of 2V (±50 mV) at 1 kHz with no offset. If the output is incorrect preform the resistor check as follows:

   a. Move switch S1 to the test position (to the left).

   b. Measure the voltage drop across R87. It should be 1V ±20%. If this voltage is incorrect, the 10 mA current source on the Oscillator Wideband SMD (A13A1) assembly if probably at fault.

   c. Verify that the voltage at TP2 is about +3.2V ±0.3V. If this voltage is incorrect, the output stage circuit is probably at fault. If this voltage is correct the Oscillator Wideband SMD (A13A1) assembly is probably at fault.

   d. Return the switch to the operate position (move to the right).

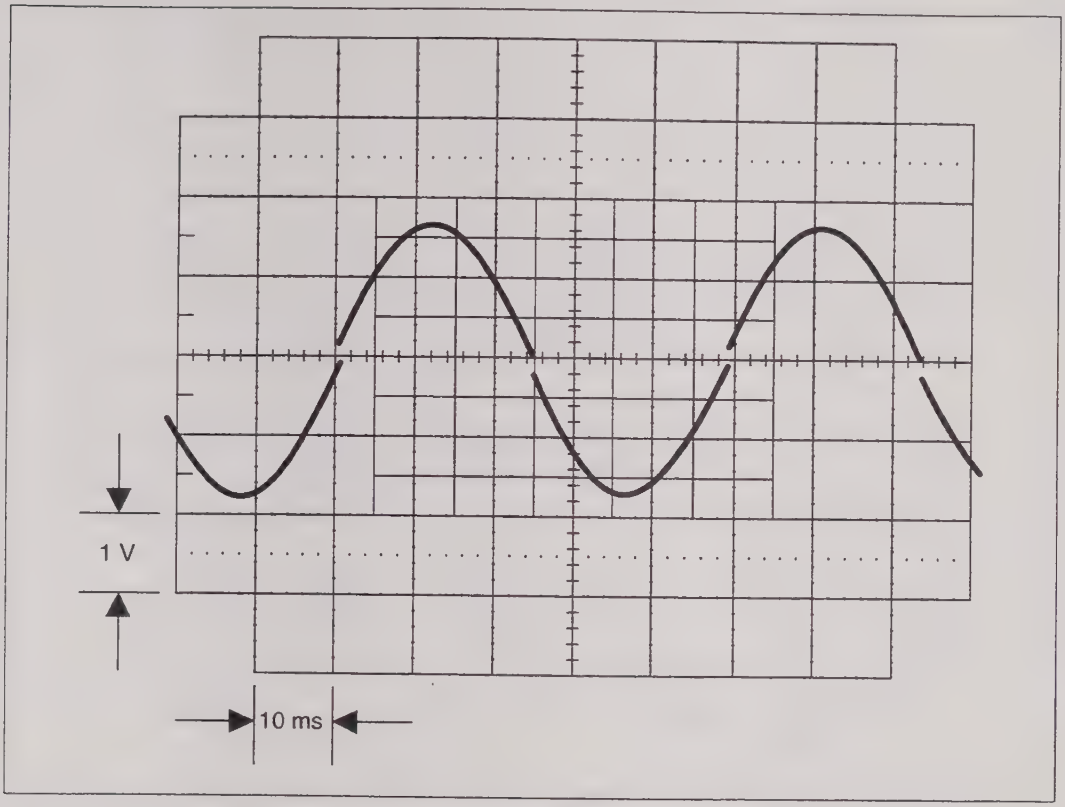

Figure 5-27. Waveform at Anode of CR4

9. Check the amplitude control within the 2.2V range. Set the 5700A for 1V at 1 kHz, operate. Edit the amplitude digits and verify the output changes accordingly. If a problem is detected, edit the output digits again and check each bit (A0-A7) of the AMPL DATA bus to ensure they toggle between +5V and ground. If they do not, U12 is probably faulty. If the AMPL DATA bus is operating, the resistive DAC U11 is probably at fault.
10. Check the 22V range output of the Oscillator. Set the 5700A for 20V at 1 kHz, operate. Check the output at TP2 (common to TP1) for an undistorted sine wave of 20±0.5V at 1 kHz. If the output is incorrect, check range setting relay K4 and its associated resistor.
11. Check the Phase Lock circuit. Connect a frequency counter to the 5700A output. Set the 5700A to 2V at 1 kHz, operate, and check the frequency accuracy to be within 0.01% of the nominal. If the frequency is out of tolerance, proceed as follows:
    a. Check the ZERO CROSSING DETECTORS by connecting an oscilloscope to U23 pins 7 and 12 (common = TP1). Ensure they convert the sine wave inputs to square wave outputs.
    b. Check the PHASE DETECTOR outputs by connecting an oscilloscope to U22 pins 5 and 7. With the circuit not phased locked one of these points should be pulsing. If not, check U22 and associated components.
    c. Check the LOOP FILTER & CHARGE PUMP circuit by connecting an oscilloscope to TP7. With the circuit not phase-locked, TP7 should be either +13V or -13V. If this voltage is incorrect, check U17, U31A, and associated components. If this voltage is correct, the problem is probably U19 and/or U15 in the MULTIPLIER circuit.

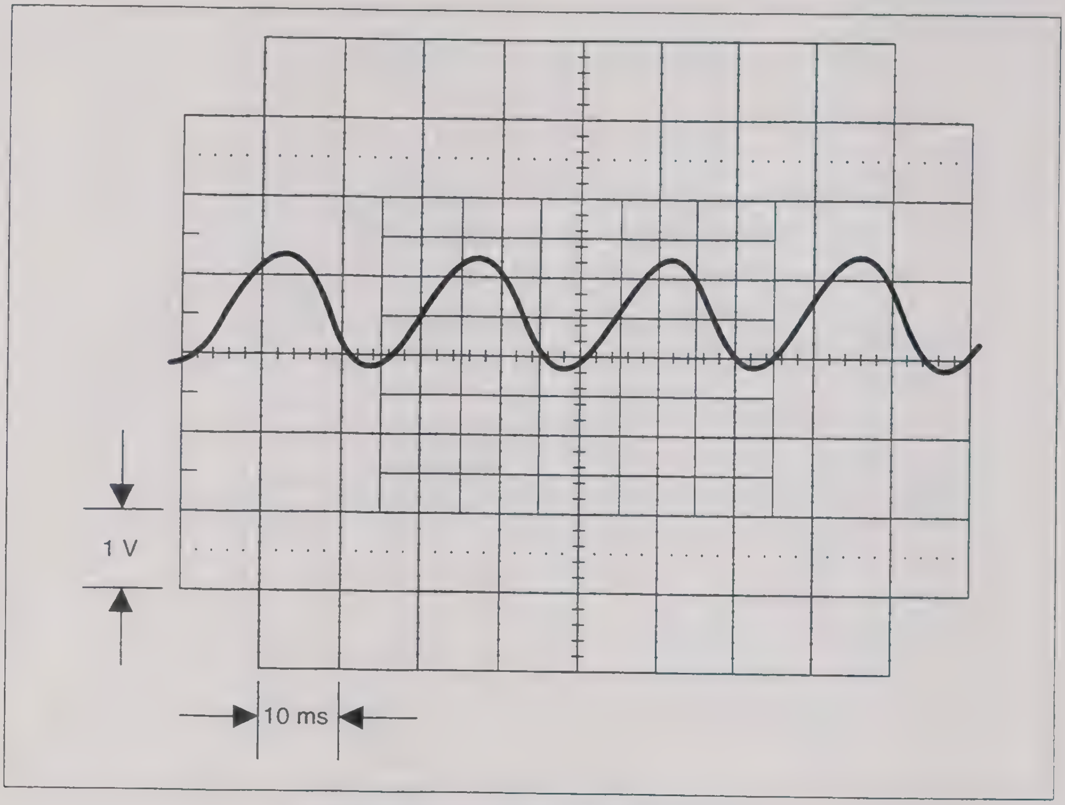

Figure 5-28. Waveform at Pin 6 of U11

12. Check the PHASE SHIFTER circuit. Using a dual-channel oscilloscope connect one channel to the TP2 (oscillator output), and the other channel to TP8 (P SHIFT HI). Set the 5700A to 2V at 1 kHz, operate. On the front panel select the "Phase Ctrls Menu" softkey, followed by the "Phase Shift" softkey to turn the phase shift function on. The oscilloscope should show two sine waves that are in phase. By pressing the "Adjust Phase Shift" softkey and then either the softkeys or rotating the edit knob the phase between these two signal should shift over the entire 360 degree range. If a failure is detected, first check the control lines for this circuit. On U27 check pin 6 (INHPH) for a logic low, pin 9 (BPH) and pin 10 (APH) should toggle between a logic high and low depending on the degrees of phase shift selected. If these control lines are incorrect, check U33. If the control lines are correct check U27, U28, and the associated components in the PHASE SHIFTER circuit.

Troubleshooting the High Voltage Control Assembly (A14) 5-19.

1. Remove the rear shield from the High Voltage Control assembly and place it on the extender card. All measurements will be referenced to PACOM (TP6) unless noted otherwise. Power up the 5700A and proceed as follows.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN TROUBLESHOOTING THE HIGH VOLTAGE CONTROL ASSEMBLY.

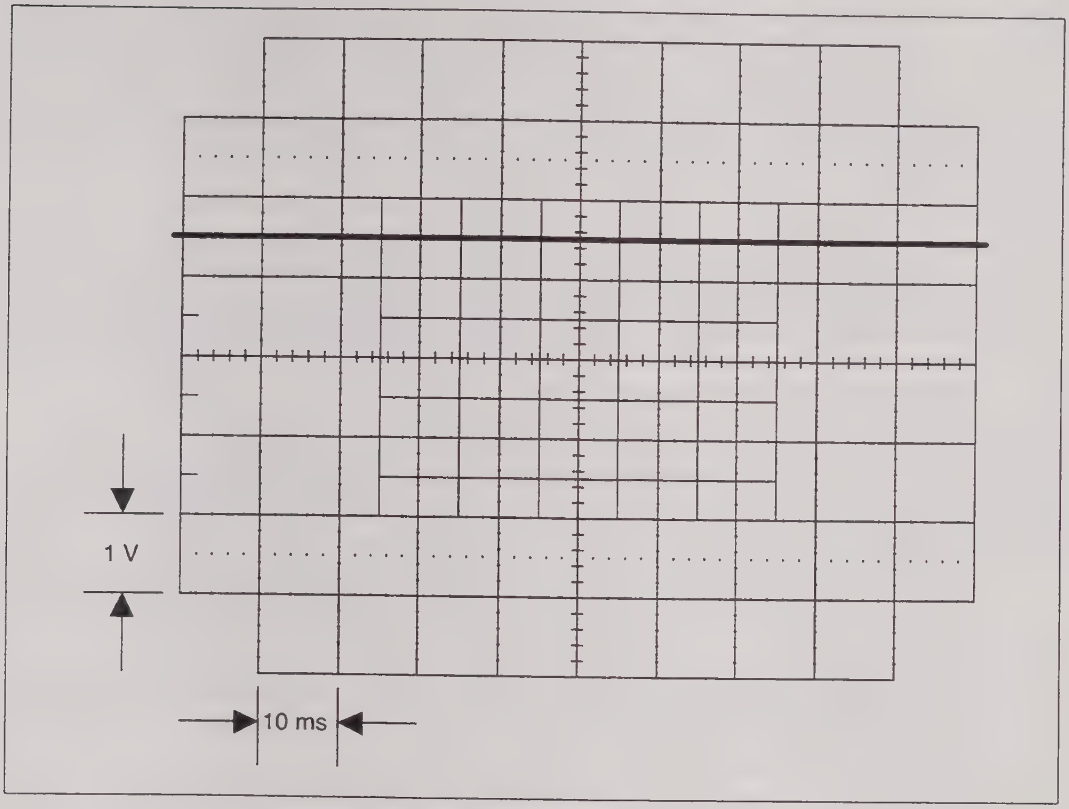

Figure 5-29. DC Sense Buffer Waveform TP6

2. Measure the voltage at TP4 with a DMM and verify it is between +0.1 and +0.3V. If a failure is detected, check U2C, U6, and associated components. Next, power down the 5700A and connect an oscilloscope, set for 20V/div and 500 µs/div, to TP3. At power up of the 5700A the oscilloscope should displays a 1 kHz square wave which ramps up to the level shown in Figure 5-31, remains there for approximately 1 second, and goes to a 0V. If a failure is detected, skip to the Magnitude Control circuit troubleshooting in this section.

NOTE

The following step 3 checks the operation of the High Voltage Control assembly in the 1100V AC Range. If may be useful to refer to Figure 2-25 in the Theory of Operation Section.

3. Check the High Voltage Control in the 1100V ac range. Set the 5700A to 220V at 110 Hz and 130 Hz, operate. At both output frequencies measure with a DMM the ac voltage at pin 1A or 1C of connector P611 and verify it reads 220±0.2V. In this range the High Voltage Control assembly and Power Amplifier assembly work together to form an overall amplifier with a gain of -100. If a failure is detected, check T1, K1, K14, K15, K16, K9, K6, K5, K12, and K3.

NOTE

Steps 4 through 7 check the operation of the High Voltage Control assembly in the 1100V DC Range. If may be useful to refer to Figure 2-26 in the Theory of Operation Section.

4. Check the -SP C and +SP C from the High Voltage/High Current assembly. Set the 5700A to 0V standby. Using a DMM, measure the dc voltage at the cathode of VR4 (-SP C) and verify it is between +13.2 and +14.2V. Next, measure the anode of VR5 (+SP C) and verify it is -0.1V to -0.3V. If a failure is detected, the HV DC Output Series Pass & Current Limit Circuit on the High Voltage/High Current (A15) assembly may be at fault.

5. Check the output from the Magnitude Control circuit. Set the 5700A to +220V dc, operate. Connect an oscilloscope to TP3 and verify it displays a signal similar to the previously shown Figure 5-31, except the amplitude is typically 10V p-p. The measured amplitude may not be 10V p-p, for now just verify that the 1 kHz signal is present. If a failure is detected, skip to the Magnitude Control circuit troubleshooting in this section.

6. Check the High Voltage Control in the 1100V dc Range. Set the 5700A to +220V dc, operate. Using a DMM, measure the dc voltage across capacitor C1 and verify it is 227V ±1V. A problem with the Magnitude Control circuit may cause this voltage to be much greater that 227V. If no dc voltage is present check T1, K9, K6, CR1-CR4, and associated components. If the measure voltage is much greater than 227V skip to the Magnitude Control Circuit troubleshooting starting at step 10.

7. Check HV OUT from the High Voltage Control assembly. Set the 5700A to +220V dc, operate. Using a DMM measure the dc voltage at pin 1A or 1C of P611 and verify it reads +220V ±0.2V. If a failure is detected, check K4, K11, K5, K12, K3, and associated components.

NOTE

The following steps 8 and 9 check the operation of the High Voltage Control assembly in the 2.2A Current Range. For these checks it will be necessary to install a jumper connecting the front panel OUTPUT HI binding post to the OUTPUT LO binding post. If may be useful to refer to Figure 2-27 in the Theory of Operation Section.

8. Check the output from the Magnitude control circuit. Set the 5700A to 220 mA dc at 1 kHz, operate. Connect an oscilloscope to TP3 and verify it displays a signal similar the previously shown Figure 5-31, except the amplitude is typically 40V p-p. The measured amplitude may not be 40V p-p, for now just verify that the 1 kHz signal is present. If a failure is detected, skip to the Magnitude Control circuit troubleshooting in this section.

9. Check the High Voltage Control assembly in the 2.2A Range. Set the 5700A to 220 mA at 1 kHz. operate. Connect the DMM low to VICOM (pins 16A/C of P612) and the DMM high to VI+ (pins 15A/C of P612) and verify it is +5.3V ±10%. Next, move the DMM high to VI- (pins 14A/C of P612) and verify it is -5.3 ±10%. If a failure is detected. check T1. K14. K2. CR5. and associated components in the 2A Range Power Supply Filter circuit.

NOTE

Remove the front panel jumper connecting OUTPUT HI to OUTPUT LO before continuing.

MAGNITUDE CONTROL CIRCUIT 5-20.

Proceed as follows to troubleshoot the magnitude control circuit:

1. Check the Square Wave Generator. Power down the 5700A and connect the oscilloscope, set for 2V/div and 500 µs/div, to TP2. When the 5700A is turned on, the oscilloscope should display a TTL-level 1 kHz square wave for approximately 1 second. If a failure is detected, check U4, U7A, and associated components in the Square Wave Generator.
2. Check the Reference and Error Amplifier. Power down the 5700A and connect an oscilloscope, set for 5V/div, to the cathode of CR10. At power up of the 5700A the oscilloscope should display a dc voltage which ramps up to approximately +14V and remains there for approximately 1 second before returning to 0V. If a failure is detected, check U2D, U7B, Q2, Q4, VR1, and associated components in the Reference and Error Amplifier circuit.
3. Check the Square Wave Amplifier. Power down the 5700A and connect an oscilloscope, set for 5V/div, to pin 1 of U1. At power up of the 5700A the oscilloscope should display a dc voltage which ramps down to approximately -14V and remains there for approximately 1 second before returning to 0V. If a failure is detected, check U1A and associated components. If this voltage is correct and at power up there is still no signal at TP3 during power up then check U3, U7C/D, and associated components in the Square Wave Amplifier circuit.
4. Check the Absolute Value Circuit. Add a jumper connecting the front panel OUTPUT HI binding post to the OUTPUT LO binding post. Set the 5700A to 1.0A at 1 kHz, operate. Connect an oscilloscope to G OUT (pin 12C of P612) and note the amplitude of the positive wave peaks. Next, connect the oscilloscope to U2 pin 7 and verify the dc voltage is equal the previously noted positive peaks of ac voltage. If a failure is detected, check U2A, U2B, and associated components in the Absolute Value Circuit.

NOTE

Remove the front panel jumper connecting OUTPUT HI to OUTPUT LO before continuing.

5. Check the Signal/Polarity Selection. Set the 5700A to 220V dc operate. Using a DMM measure the dc voltage at TP4 and verify it is +6 to +8V. Next, set the 5700A to -220V dc operate and again verify that the dc voltage at TP4 remains between +6 and +8V. If a failure is detected, check U2C, U6, and associated components in the Signal/Polarity Selection circuit.

Troubleshooting the High Voltage/High Current Assembly (A15) 5-21.

Proceed as follows to troubleshoot the High Voltage/High Current Assembly (A15):

1. Remove the rear shield from the High Voltage/High Current assembly and place it on the extender card. All measurements will be referenced to ACOM (TP7) unless noted otherwise. Power up the 5700A and proceed as follows.

WARNING

HIGH VOLTAGES ARE EXPOSED WHEN TROUBLESHOOTING THE HIGH VOLTAGE/HIGH CURRENT ASSEMBLY.

2. Check the ±20S supplies. Set the 5700A to 0V dc, standby. Measure with a DMM the dc voltage at the cathode of VR3 and verify it is 20V ±5%. Next, measure the dc voltage at the anode of VR4 and verify it is -20V ±5%. If a failure is detected, check VR3, VR4, and associated components.
3. Check the power-up standby voltages. Set the 5700A to 0V standby. Using a DMM measure the dc voltage at TP5 and verify it is 0V ±50 µV. If a failure is detected, proceed with step 4, otherwise skip to step 6.

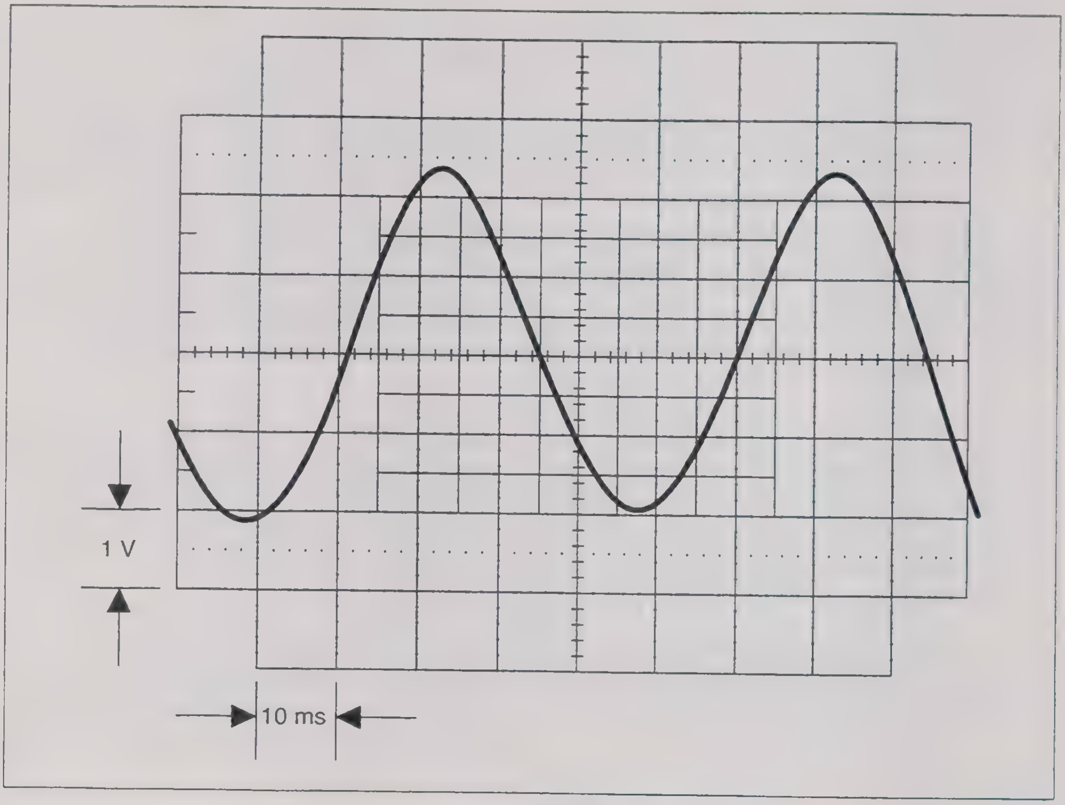

Figure 5-30. AC Sense Buffer Waveform at TP6

4. Check Buffer U1. Measure the dc voltage at TP3 and note the polarity. Next, measure the dc voltage at TP5 and verify that it is the opposite polarity. If a failure is detected, check U1 and associated components.

5. Check the HR7 Hybrid and U2. Measure the dc voltage at pin 10 of the HR7 Hybrid and note the polarity. Next, measure the dc voltage at TP3 and check that it is the opposite polarity. If a failure is detected, check the HR7 Hybrid, U2, and associated components.

6. Check -SP C and +SP C at power up standby. Using a DMM, measure the dc voltage at TP4 (-SP C) and verify it is between +13.2 and +14.2V. Next measure the dc voltage at TP6 (+SP C) and verify it is between -0.1 and -0.3V. If a failure is detected, check Q3, Q4, Q6, and associated components in the HV DC Output Series Pass & Current Limit circuit.

7. The following step 8 checks the High Voltage/High Current assembly in the 1100V ac range. To better understand of function of this assembly during this mode of operation refer to Figure 2-25 in the Theory of Operation section. During normal operation in the 1100V ac mode, internal software monitors the output and makes corrections or trips the instrument into standby. This internal monitoring can cause difficulty when troubleshooting a faulty High Voltage assembly. If during the next step 8 the instrument keeps tripping into standby, defeat the monitoring by connecting a jumper from TP9 to TP10 on the DAC assembly.

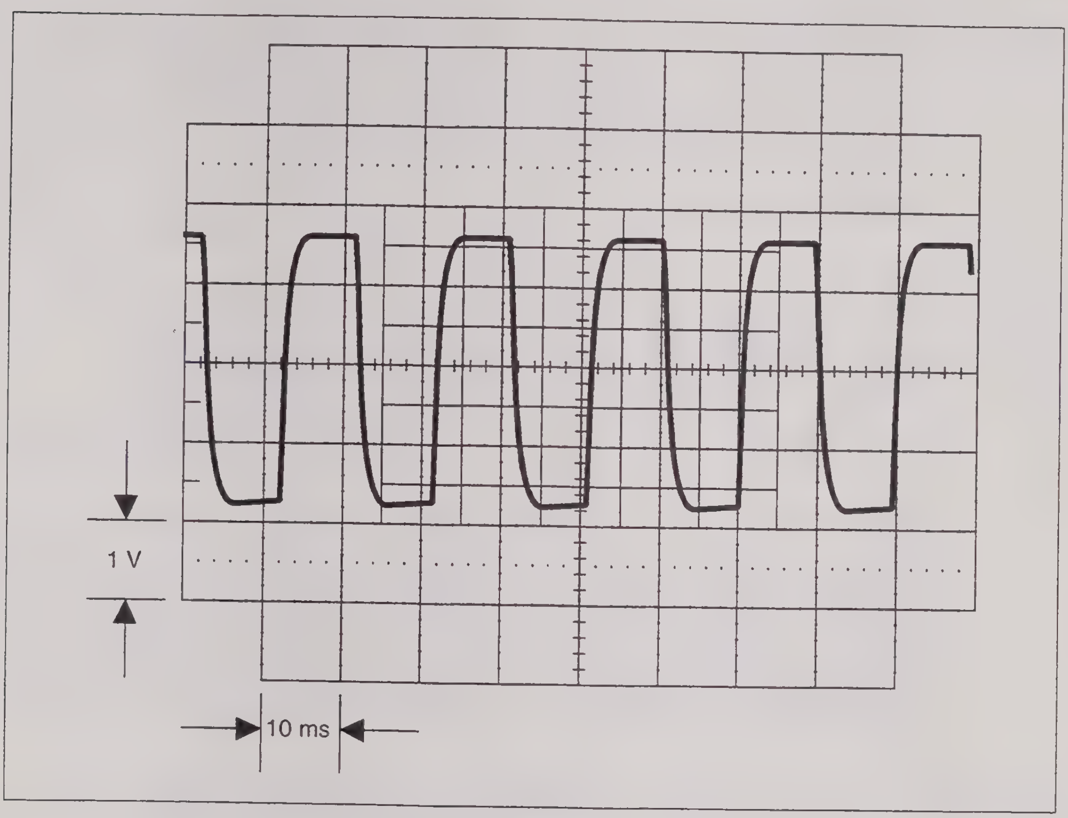

Figure 5-31. Waveform at TP3

8. Check the 1100V ac range. Set the 5700A to 220V at 130 Hz, operate. Using a DMM, measure the ac voltage at pin 1 of the HR7 resistor network. Note the DMM reading and verify it is 220V ac ±0.1V. Next, measure the voltage at TP5 and verify it is 1/100th of the voltage noted at pin 1 of the HR7 resistor network. If a failure is detected, check the HR7 Hybrid assembly, U2, U1, K6, K1, K4, and associated components.

NOTE

Remove the jumper connecting TP9 to TP10 on the DAC assembly before continuing. Steps 10 through 12 check the High Voltage/High Current assembly in the 1100V dc range. To better understand the function of this assembly during this mode of operation, refer to Figure 2-26 in the Theory of Operation section.

9. Check the 1100VDC Range input voltage. Set the 5700A to 220V dc, operate. Using a DMM measure the dc voltage at TP1 and verify it is -2.2V ±1 mV. If a failure is detected, check K1 and its drive circuit.

10. Check the 1100VDC Range DC HV Amplifier. Set the 5700A to 220V dc, operate. Measure the dc voltage at TP3 with a DMM and verify it is 0.55±0.2V. Next, set the 5700A to -220V dc, operate. Again measure the dc voltage at TP3 and verify it is now 2.3±0.2V. If a failure is detected, check the HR7 Hybrid assembly, U2, K5, K7, K14, and associated components.

11. Check -SP C and +SP C in the 1100V dc range. Set the 5700A to +220V dc, operate. Using a DMM, measure the dc voltage at TP4 (-SP C) and verify it is between +13.2 and +14.2V. Also measure the dc voltage at TP6 (+SP C) and verify it is between -6 and -8V. Next, set the 5700A to -220V dc, operate. Again measure the dc voltage at TP4 and TP6. In this mode TP4 should be between +6 and +8V, and TP6 should be between -13.2 and -14.2V. If a failure is detected, check Q3, Q4, Q6, and associated components.

NOTE

Steps 12 through 14 check the High Voltage/High Current assembly in the 2.2A Current range. For these checks it will be necessary to install a jumper connecting the front panel OUTPUT HI binding post to the OUTPUT LO binding post. To better understand the function of this assembly during this mode of operation refer to Figure 2-27 in the Theory of Operation section.

12. Remove the hybrid cover from the H4 assembly. Unsolder the right end of resistor R37 (node with R37, Z5 pins 2 and 3), labeled G+ on the schematic, and lift this end out of the circuit board. Connect an external ac reference to the lifted end of R37 and reinstall the assembly on the extender card. Power up the 5700A. Set the external ac reference to 1V at 1 kHz and connect an oscilloscope to the output of the H4 Hybrid (node with R42, R44, and H4 pin 18). Verify the oscilloscope displays a square wave similar to Figure 5-32. If a failure is detected, check the H4 Hybrid assembly.

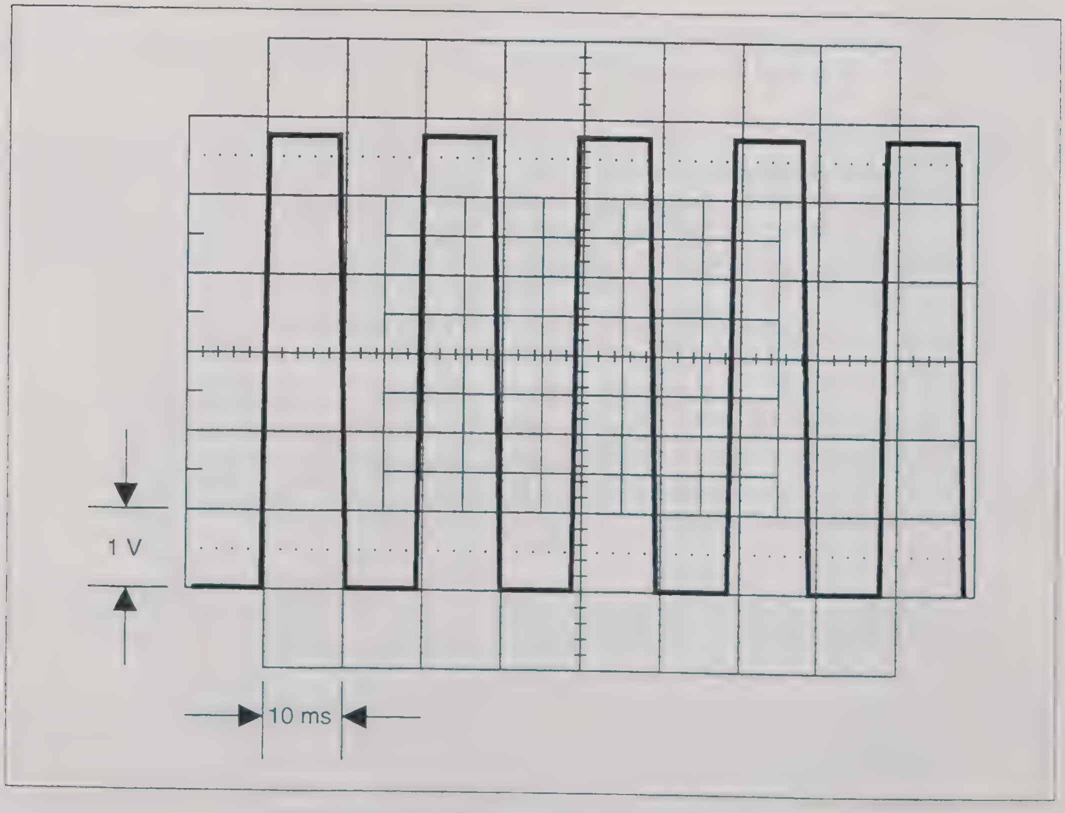

Figure 5-32. Waveform at Pin 18 of Hybrid H4

13. Connect an oscilloscope to pin 7 of U3B and verify it displays a square wave equal to the positive peaks of Figure 5-32. Next, connect the oscilloscope to pin 1 of U3A and verify it displays a square wave equal to the negative peaks of Figure 5-32. If a failure is detected, check U3 and associated components.

NOTE

Reinstall the lifted end of R37, solder it to the circuit board, and reinstall the H4 Hybrid cover before continuing.

14. Check the 2.2A current range. Set the 5700A to 0A in the 2.2A Range by range locking the instrument in the 2.2A range and calling up 0A. Using a DMM, measure the dc voltage across R57 and verify it is 0.028V ±25%. Next, measure the dc voltage across R68 and verify it is 0.028V ±25%. If a failure is detected, check U4, U5, Q11-Q16, and associated components.

Troubleshooting the Power Amplifier Assembly (A16) 5-22.

NOTE

During normal 5700A operation, internal software monitors the output and makes corrections or trips the instrument to standby. This internal monitoring can cause problems when attempting to troubleshoot the Power Amplifier assembly. Defeat the monitoring by connecting a jumper from TP9 to TP10 on the DAC assembly and another jumper connecting TP1 on the Oscillator Output (A13) assembly to the bottom of R8 (node with R8, C42, C43, and pin 6 of U6) on the Oscillator Control (A12) assembly.

After disabling the internal moitoring loop, remove the rear shield and front air duct from the Power Amplifier assembly. Place the assembly on the extender card and proceed as follows to troubleshoot the Power Amplifier assembly (A16):

1. Power up the 5700A. In the following steps, reference all measurements to PACOM (TP10) unless otherwise noted.
2. Set the 5700A to 22V at 1 kHz, operate. This configures the Power Amplifier assembly as an amplifier with a gain of -10 as shown in Figure 5-33. Check the input for the correct voltage. Using a DMM, measure the ac voltage at TP3 and verify it is 2.2V ±5%. If this voltage is incorrect, check relay K10A and its drive circuit. Next, measure the output of the Power Amplifier. Using a DMM, measure the voltage at TP6 and verify it is 10 times that measured at TP3 ±5%. Also measure the dc offset at TP6 and verify it is less than 10 mV. If this voltage is incorrect, proceed with step 3. If the output voltage is correct skip to step 8.
3. Before troubleshooting the main Power Amplifier loop, switch the ±PA supplies to the low voltage (±40SR Supplies) mode by switching switch SW201 on the Filter/PA Supply assembly. Using a DMM, measure the ±PA supplies and verify they are ±60V ±15V. If a failure is detected, the Filter/ PA Supply assembly may be at fault.
4. Check the Bias Current circuit. Set the 5700A to 0V dc, standby. Connect an external 100Ω 1/4W carbon-film resistor between PACOM (TP10) and 1ST MID STAGE OUT which is the left side of 1W resistor R41. Using a DMM, measure the mid stage output (1ST MID STAGE OUT), which is the left side of R41, and verify the dc voltage is either +0.8V ±0.2V or -1.1V ±0.2V. If this voltage is correct skip to step 6. If it is incorrect, remove Q12 from the assembly and recheck the Mid-Stage output. With Q12 removed, the Mid-Stage output should be 0.8V ±0.2V. If this voltage is incorrect, check CR53, Q31, Q32, and associated components in the Current Source Circuit. If the voltage is correct then the Input Stage or Mid-Stage circuitry is probably at fault.

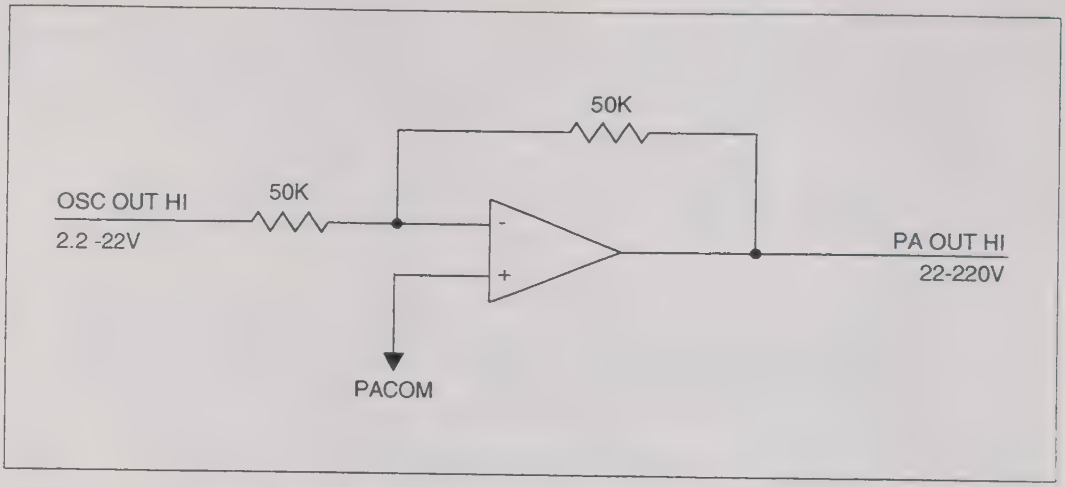

Figure 5-33. Power AMplifier with 5700A Set to 22V at 1 kHz

5. Check the Input Stage and Mid-Stage. Set the 5700A to 0V dc, standby. Using a DMM check measure the voltage at pin 10 of the HR8 hybrid and note whether it is positive or negative. Next, measure the Input Stage output at TP4 and verify it is properly inverting. If a failure is detected, the Input Stage circuit is probably at fault. If the Input Stage is properly inverting, the Mid-Stage circuit is probably at fault.
6. Check the Output Stage Bias Current. Set the 5700A to 0V dc, standby. Connect an external 100Ω 1/4W carbon-film resistor between PACOM (TP10) and 1ST MID STAGE OUT which is the left side of 1W resistor R41. Using a DMM measure the Output Stage bias current by measuring the dc voltage between TP14 and TP15, verify it is 0.92V ±20%. If a failure is detected, check Q7, Q4, Q5, Q10, Q11, and associated components.
7. Check the output of the Output Stage. Set the 5700A to 0V dc, standby. Connect an external 100Ω 1/4W carbon-film resistor between PACOM (TP10) and 1ST MID STAGE OUT, which is the left side of 1W resistor R41. Measure the dc voltage at the Mid-Stage output as is step 4. If the voltage is +0.8V, then the voltage at TP6 (PA OUT HI) should be +3.2±0.3V. If the voltage measured at the Mid-Stage output is -1.1V, then the voltage at TP6 should be +1.3±0.3V. If a failure is detected, check the components in the Output Stage Circuit.

NOTE

If switch SW201 on the Filter/PA Supply assembly was set to the low voltage mode, switch it back to the normal (±PA) mode before continuing.

8. Check the 220V RANGE AC ATTENUATOR. Connect a jumper from TP9 to TP10 on the DAC assembly and another jumper connecting TP1 on the Oscillator Output (A13) assembly to the bottom of R8 (node with R8, C42, C43, and pin 6 of U6) on the Oscillator Control (A12) assembly as done in the previous step 1. Set the 5700A to 22V at 1 kHz, operate. Testing of this 220V Range AC Attenuator is divided into three steps. Measure the ac voltage with a DMM at TP6 (the Power Amplifier output), then measure the voltage at TP7 (Attenuator input) and verify they are the same ±10 mV. If a failure is detected, check relay K16B and its drive circuit.

NOTE

If relay K16B is not at fault, then PA OUT HI may be open from PA SENSE AC elsewhere in the 5700A.

9. Measure the ac voltage at TP8 with a DMM and verify it equals the voltage measured at TP7 divided by 100 ±1%. Also use an oscilloscope and check for any distortion at TP8. If a failure is detected, check Z1, U4, Q58, Q54, and their associated components. Next, using a DMM, measure the ac voltage at pin 8 of K11 and verify it is the same as measured at TP8. If a failure is detected, check relays K10B, K11, and their drive circuit.

10. Check the SC+ and SC- supplies. Set the 5700A to 0V dc, standby. Using a DMM, measure the SC+ supply at U1 pin 7 and verify it is +18V ±10%. Next, measure the DC- supply at U1 pin 4 and verify it is -15V ±10%. If a failure is detected, check zener diodes VR15 and VR18.

NOTE

Remove any jumpers left in place from step 8 before continuing.

11. Check the SENSE CURRENT CANCELLATION circuit. Set the 5700A to 100V dc, operate. Using a DMM, measure the voltage between pin 6 of U1 and TP1, and verify it is 2V ±25 mV. If a failure is detected, check U1 and its associated components.

NOTE

Step 12 should be done only when a problem with calibration of the 220V dc range exists.

12. Check the 220V DC INT. CAL. NETWORK. Set the 5700A to 0V dc, standby. Connect a jumper from U5 pin 1 to SCOM (TP11). Using a DMM measure the 13V reference at TP2 of the DAC assembly (common to TP3) and note the reading. Next, measure the buffered 13V reference at TP12 of the Power Amplifier and verify it is the same. If a failure is detected, check U5, K3, and their drive circuit. Next, using a DMM, measure the voltage at U9 pin 6 and verify it is the equal to the voltage at TP12 divided by 8 ±1%. If a failure is detected, check the HR8 resistor network, U9, and the associated components.

Troubleshooting the Filter/PA Supply Assembly (A18) 5-23.

Proceed as follows to troubleshoot the Filter/PA Supply assembly (A18):

1. Place the Filter/PA Supply assembly on the extender card. Remove the Power Amplifier assembly (A16) and power up the 5700A. Reference all measurements to PACOM (TP203). The 5700A should be in its power-up default standby condition unless otherwise noted.

2. Check the unregulated ±250V Supplies. Using a DMM, measure the dc voltage at the cathode of CR235 or CR239 and verify it is -280V ±10%. Next, measure the dc voltage at the anode of CR208 or CR203 and verify it is +280V ±10%. Connect an oscilloscope to these points and verify the ripple is less than 5V p-p. If a failure is detected, check CR222, F202, F203, and associated components.

3. Check the unregulated ±500V Supplies. Using a DMM measure the dc voltage at TP209 and verify it is +565 ±10%. Next, measure the dc voltage at TP211 and verify it is -565 ±10%. Connect an oscilloscope to these points and verify the ripple is less than 5V p-p. If a failure is detected, check CR217, CR218, CR220, CR221, CR223, CR224, CR227, CR228, F201, F204, and associated components.

4. Check the Control Lines. Using a DMM, measure the dc voltage at TP205, TP207, and TP208. Verify they are all at +12V ±4V. Next measure the dc voltage at pins 13 and 14 of U201. Verify they are at - 12V ±4V. If a failure is detected, check Z201, U201A, U201B, and associated components.

5. Check the unregulated +250V Supply. Using a DMM, measure the dc voltage at TP210 and verify it is +280 ±10% If a failure is detected, measure the voltage at the cathode of VR211 and verify it is +140 ±20%. If this voltage is incorrect, check VR211, VR214, VR215, VR219, and Q208. If the voltage at the cathode of VR211 is correct then check Q201, CR201, CR203, CR208, CR210, and associated components.

6. Check the regulated +PA Supply at 0V. Using a DMM measure the dc voltage at TP201 and verify it is less than 1.0V. If a failure is detected, check Q207.

7. Check the regulated +PA Supply at +180V. Jumper TP207 to PACOM (TP203), measure the +PA Supply at TP201 and verify it is +190V ±10%. If this voltage is correct, skip to step 8, otherwise continue as follows. Measure the output of the Current Limit circuit. Connect a DMM to pin 1 of U201 and verify it is -12±4V. If this voltage is incorrect, then the +PA Supply is current-limited. Check the output for shorts and check the current-limiting circuit contained in U201C, Q203, Q206, and associated components. If the voltage at pin 1 of U201 is correct, check Q205, Q202, VR212, VR207, and associated components.

8. Check the unregulated +PA Supply at +360V. Jumper TP207 and TP205 to PACOM (TP203), measure the voltage at TP210 and verify it is +480V ±10%. If a failure is detected, check Q208, VR214, VR215, VR219, CR201, CR203, CR208, CR210, and associated components. Next, check the regulated +PA Supply at TP201 and verify it is +370V ±10%. If a failure is detected, check Q205 and VR216.

9. Check the Current Limiting of the +PA Supply. Jumper TP207 to PACOM (TP203) and remove the jumper connecting TP205 to PACOM installed in the previous step. Connect an oscilloscope to the +PA Supply at TP201. Connect a 1 kΩ 10W resistor (such as Fluke P/N 157933) between PACOM (TP203) and the +PA supply output at Jumper J201. The +PA supply (at +180V) should go into current limit. The oscilloscope should show a repeating pattern in which the +PA supply climbs to about +180V then drops to 0V. If a failure is detected, check Q203, VR246, VR213, U201C, and associated components.

10. Check the unregulated -250V Supply. Using a DMM, measure the dc voltage at TP212 and verify it is -280V ±10%. If a failure is detected, measure the voltage at the anode of VR231 and verify it is -140V ±20%. If this voltage is incorrect, check VR231, VR230, VR229, VR225, and Q209. If the voltage at the anode of VR231 is correct, then check Q215, CR234, CR235, CR239, CR243, and associated components.

11. Check the regulated -PA Supply at 0V. Using a DMM, measure the dc voltage at TP204 and verify it is less than 1.0V. If a failure is detected, check Q212.

12. Check the regulated -PA Supply at -180V. Jumper TP207 to PACOM (TP203), measure the -PA Supply at TP204 and verify it is -190V ±10%. If this voltage is correct, skip to step 13, otherwise continue as follows. Measure the output of the Current Limit circuit. Connect a DMM to pin 2 of U201 and verify it is +12±4V. If this voltage is incorrect, then the -PA Supply is in current limit. Check the output for shorts and check the current-limiting circuit contained in U201D, Q211, Q214, and associated components. If the voltage at pin 2 of U201 is correct check Q210, Q216, VR232, VR238, and associated components.

13. Check the unregulated -PA Supply at -360V. Jumper TP207 and TP208 to PACOM (TP203), measure the voltage at TP212 and verify it is -480V ±10%. If a failure is detected, check Q209, VR225, VR229, VR230, CR234, CR235, CR239, CR243, and associated components. Next, check the regulated -PA Supply at TP204 and verify it is -370V ±10%. If a failure is detected, check Q210, and VR226.

14. Check the Current Limiting of the -PA Supply. Jumper TP207 to PACOM (TP203) and remove the jumper connecting TP208 to PACOM installed in the previous step. Connect an oscilloscope to the -PA Supply at TP204. Connect a 1 kΩ 10W resistor (such as Fluke P/N 157933) between PACOM (TP203) and the -PA supply output at Jumper J202. The -PA supply (at -180V) should go into current limit. The oscilloscope should show a repeating pattern in which the -PA supply climbs to about -180V then drops to 0V. If a failure is detected, check Q214, VR247, VR233, U201D, and associated components.

Section 6

List of Replaceable Parts

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A12 Oscillator Control PCA	5700A-7650	6-15	6-51	6-15	6-54
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A13A1 Oscillator Wideband SMD PCA	5700A-7652	6-17	6-59	6-17	6-60
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INTRODUCTION 6-1.

This section contains an illustrated list of replaceable parts for the 5700A. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator
- An indication if the part is subject to damage by static discharge
- Description
- Fluke stock number
- Manufacturers supply code
- Manufacturers part number or generic type
- Total quantity
- Any special notes (i.e., factory-selected part)

CAUTION

A ϟ symbol indicates a device that may be damaged by static discharge.

HOW TO OBTAIN PARTS 6-2.

Electrical components may be ordered directly from the manufacturer by using the manufacturers part number, or from the John Fluke Mfg. Co., Inc. and its authorized representatives by using the part number under the heading FLUKE STOCK NO. A list of manufacturers supply codes is provided at the end of this section. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representatives.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Fluke stock number
- Description (as given under the DESCRIPTION heading)
- Quantity
- Reference designator
- Part number and revision level of the pca containing the part.
- Instrument model and serial number

MANUAL STATUS INFORMATION 6-3.

The Manual Status Information table that precedes the parts list defines the assembly revision levels that are documented in the manual. Revision levels are printed on the component side of each pca.

SERVICE CENTERS 6-4.

A list of service centers is located at the end of this section.

MANUAL STATUS INFORMATION

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	REVISION LEVEL
A1	Keyboard PCA	761049	C
A2	Front Panel PCA	761031	C
A3	Analog Motherboard PCA	761023	C
A4	Digital Motherboard PCA	760942	F
A5	WideBand Output PCA	761346	G
A6	Wideband Oscillator PCA	761098	J
A7	Current/High-Resolution Oscillator PCA	764613	N
A8	Switch Matrix PCA	761106	L
A9	Ohms Cal PCA	775395	H
A10	Ohms Main PCA	761114	D
A11	DAC PCA	761122	K
A11A1	DAC Filter SIP PCA	761395	A
A11A2	DAC Buffered Reference	764639	-
A12	Oscillator Control PCA	761130	K
A13	Oscillator Output PCA	761148	H
A13A1	Oscillator Wideband PCA	761403	A
A14	High Voltage Control PCA	775429	F
A15	High Voltage/High Current PCA	761155	G
A16	Power Amplifier PCA	761163	U
A16A1	Power Amplifier Digital Control SIP PCA	775320	C
A17	Regulator/Guard Crossing PCA	761171	H
A18	Filter/PA Supply PCA	761189	N
A19	Digital Power Supply PCA	761056	G
A20	CPU PCA	761072	G
A21	Rear Panel PCA	761221	H

able 6-1. Front Panel Final Assembly

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	ϟ KEYBOARD PCA	761049	89536	761049	1	
A 2	ϟ FRONT PANEL PCA	761031	89536	761031	1	
A 3	ϟ ANALOG MOTHERBOARD PCA	761023	89536	761023	1	
A 4	ϟ DIGITAL MOTHERBOTARD PCA	760942	89536	760942	1	
A 7	ϟ CURRENT/HIGH-RES OSCILLATOR PCA	764613	89536	764613	1	
A 8	ϟ SWITCH MATRIX PCAN	761106	89536	761106	1	
A 9	ϟ OHMS CAL PCA	775395	89536	775395	1	
A 10	ϟ OHMS MAIN PCA	761114	89536	761114	1	
A 11	ϟ DAC PCA	761122	89536	761122	1	
A 12	ϟ OSCILLATOR CONTROL PCA	761130	89536	761130	1	
A 13	ϟ OSCILLATOR OUTPUT PCA	761148	89536	761148	1	
A 14	ϟ HIGH VOLTAGE CONTROL PCA	775429	89536	775429	1	
A 15	ϟ HIGH VOLTAGE/HIGH CURRENT PCA	761155	89536	761155	1	
A 16	ϟ POWER AMPLIFIER PCA	761163	89536	761163	1	
A 17	ϟ REGULATOR/GUARD CROSSING PCA	761171	89536	761171	1	
A 18	ϟ FILTER/PA SUPPLY PCA	761189	89536	761189	1	
A 19	ϟ DIGITAL POWER SUPPLY PCA	761056	89536	761056	1	
A 20	ϟ CPU PCA	761072	89536	761072	1	
A 21	ϟ REAR PANEL PCA	761221	89536	761221	1	
A 22	TRANSFORMER/MODULE ASSY	813527	89536	813527	1	1
CP 1	ADAPTOR,COAX,SMA(M),N(M)	516963	21845	SF1132-6002	1	
E 1	JUMPER,LINK,BINDING POST	190728	83330	21171	1	
E 2	GROUND STRIP,COPPER,1.00X.375X.030	854836	86928	4805-38-3-T2	1	
H 5- 13	SCREW,THD FORM,PH,P,STL,5-20,.312	494641		COMMERCIAL	9	
H 20- 23	SCREW,MACH,PH,P,STL,4-40X0.187	129882		COMMERCIAL	4	
H 25- 28	SCREW,CAP,SCKT,SS,8-32,.375	837575		COMMERCIAL	4	
H 29- 31	SCREW,MACH,FHU,P,SS,LOCKIN,6-32,.250	769893		COMMERCIAL	3	
H 32- 42	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	11	
H 43	SCREW,PH,P,LOCK,SS,6-32X0.375	334458	2M530	334458	1	
MP 1	PANEL, FRONT, SHEET METAL	761437	89536	761437	1	
MP 2	SHIELD, DISPLAY PWB	764514	89536	764514	1	
MP 3	LENS, SHIELD	760843	89536	760843	1	
MP 4	DECAL, FRONT OUTPUT CABLE DIAGRAM	802967	89536	802967	1	
MP 6	GROMMET,NYLON,NAT,.056X.150X.100X.155	285254	03296	G51P-A	1	
MP 14- 16	BINDING POST-RED	850292	89536	850292	3	A
MP 14-16	BINDING POST-RED	886382	89536	886382	3	B
MP 17, 18	BINDING POST, BLACK	850297	89536	850297	2	A
MP 17, 18	BINDING POST, BLACK	886379	89536	886379	2	B
MP 19	BINDING POST, GREEN	823229	89536	823229	1	A
MP 19	BINDING POST, GREEN	886374	89536	886374	1	B
MP 20	BINDING POST,BLUE	823203	89536	823203	1	A
MP 20	BINDING POST,BLUE	886366	89536	886366	1	B
MP 21	ENCODER WHEEL	764548	89536	764548	1	
MP 22	FRONT PANEL, MOLDED	775627	89536	775627	1	A
MP 22	FRONT PANEL, MOLDED	886325	89536	886325	1	B
MP 23	KNOB, ENCODER, GRAPHITE	786590	89536	786590	1	A
MP 23	KNOB, ENCODER, GRAPHITE	868794	89536	868794	1	B
MP 24	KEYPAD, ELASTOMERIC	813469	89536	813469	1	A
MP 24	KEYPAD, ELASTOMERIC	885397	89536	885397	1	B
MP 25	DECAL, POWER ON/OFF	775759	89536	775759	1	A
MP 25	DECAL, POWER ON/OFF	886312	89536	886312	1	B
MP 26	DECAL, KEYPAD	775346	89536	775346	1	A

Table 6-1. Front Panel Final Assembly (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
MP 26	DECAL, KEYPAD	886304	89536	886304	1	B
MP 27	DECAL, FRONT OUTPUT	775742	89536	775742	1	A
MP 27	DECAL, FRONT OUTPUT	886309	89536	886309	1	B
MP 28- 34, 39	NUT, #8 LOW THERMAL	850334	89536	850334	8	
MP 35	LENS, DISPLAY	775718	89536	775718	1	
MP 36	NAMEPLATE, ELECTROFORM 3"	802868	89536	802868	1	
MP 37, 38	HANDLE, INSTRUMENT	791897	89536	791897	2	A
MP 37, 38	HANDLE, INSTRUMENT	886333	89536	886333	2	B
TM 1	5700A GETTING STARTED MANUAL	791962	89536	791962	1	
TM 2	5700A OPERATOR MANUAL	791905	89536	791905	1	
TM 3	5700A SERVICE MANUAL	791996	89536	791996	1	
NOTES:	ϟ Static sensitive part. 1. See Figure 6-1a. A. Used on S/N 5115000 and above. B. Used on S/N 5115001 and above.					

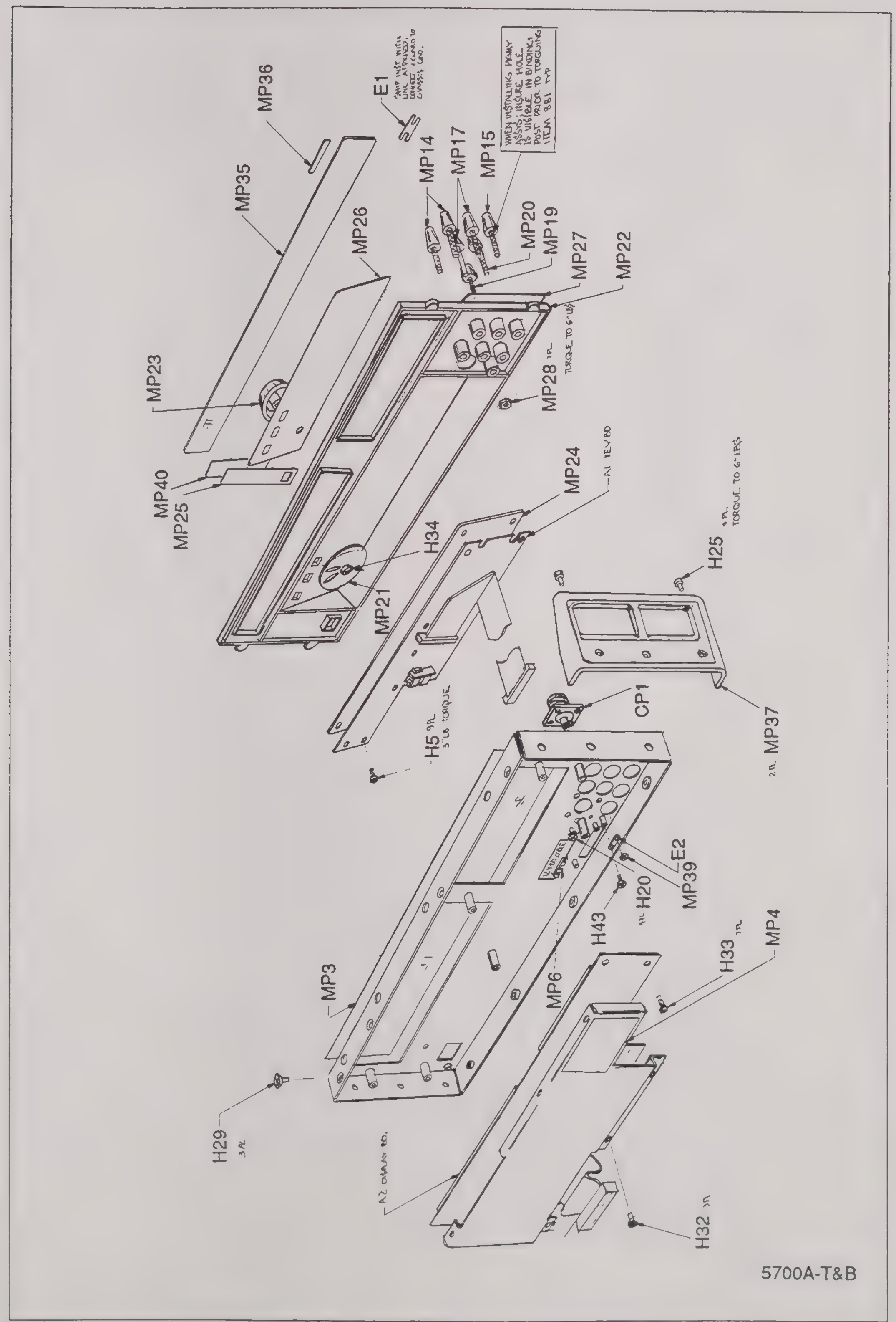
MP36
E1
SHIP INST WITH LINE ATTACHED; CONNECT LEAD TO CHASSIS GND.
WHEN INSTALLING PRIMARY ASSYS, INSURE HOLE IS VISIBLE IN BINDING POST PRIOR TO TORQUING ITEM 881 TYP
MP35
MP14
MP17
MP15
MP26
MP20
MP19
MP27
MP22
MP23
MP28 3 PL TORQUE TO 6" LBS
MP40
MP25
MP24
A1 KEYBD
H34
MP21
H25 4 PL TORQUE TO 6" LBS
H5 9 PL 3" LB TORQUE
CP1
MP37 2 PL
E2
MP39
H20 4 PL
H43
MP3
MP6
H33 3 PL
MP4
H29 3 PL
A2 DISPLAY BD.
H32 3 PL
5700A-T&B

Figure 6-1. Front Panel Final Assembly

Table 6-1a. Chassis Final Assembly

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 22	TRANSFORMER/MODULE ASSY	813527	89536	813527	1	1
B 1, 2	FAN/CONNECTOR ASSEMBLY	761213	89536	761213	2	
E 1	BINDING POST PART,HEAD,BRASS,1/4-28	102889	89536	102889	1	
F 1	FUSE,.25X1.25,1.25A,250V,SLOW	851936	71400	MDL813FLC	1	
H 1	INSULATOR, ANALOG BOTTOM	775361	89536	775361	1	
H 2- 10	SCREW,MACH,PH,P,STL,6-32,.500	152173		COMMERCIAL	9	
H 14- 20, 84, H 89- 94	SCREW,MACH,PH,P,STL,6-32X0.750	114223 114223		COMMERCIAL	14	
H 21- 42, 87, H 88,110-112	SCREW,MACH,PH,P,STL,6-32X0.250	152140 152140		COMMERCIAL	27	
H 43, 44	SCREW,MACH,PH,P,STL,6-32X0.375	152165		COMMERCIAL	2	
H 45- 56	SCREW,CAP,SCKT,SS,8-32,.375	837575		COMMERCIAL	12	
H 57- 73	SCREW,MACH,FHU,P,SS,LOCKIN,6-32,.250	769893		COMMERCIAL	17	
H 74- 81	SCREW,MACH,PH,P,STL,6-32X1.250	159756		COMMERCIAL	8	
H 85, 86, 95, H 96	WASHER,FLAT,STL,.149,.375,.031	110270 110270		COMMERCIAL	4	
H 97, 98	WASHER,FLAT,STL,.160,.281,.010	111005		COMMERCIAL	8	
H 105-108	SCREW,MACH,TH,P,STL,8-32X.250	853622		COMMERCIAL	4	
MP 1	COVER, DIGITAL	775635	89536	775635	1	
MP 2	BOTTOM COVER, ANALOG BOX	764530	89536	764530	1	
MP 3	TOP COVER, ANALOG BOX	764522	89536	764522	1	
MP 4	RELAY BRACKET	761015	89536	761015	1	
MP 5	TOP COVER, INSTRUMENT	775817	89536	775817	1	A
MP 5	TOP COVER, INSTRUMENT	886395	89536	886395	1	B
MP 6	BOTTOM COVER, INSTRUMENT	775825	89536	775825	1	A
MP 6	BOTTOM COVER, INSTRUMENT	886403	89536	886403	1	B
MP 7	SHROUD, CPU CABLE	813519	89536	813519	1	
MP 8, 24- 30	NUT, #8 LOW THERMAL	850334	89536	850334	8	
MP 11	POWER BUTTON, ON/OFF	775338	89536	775338	1	
MP 12- 15	BOTTOM FOOT, MOLDED	775791	89536	775791	4	A
MP 12- 15	BOTTOM FOOT, MOLDED	868786	89536	868786	4	B
MP 18, 19	SIDE TRIM EXTRUSION, MODIFIED	684555	89536	684555	2	A
MP 18, 19	SIDE TRIM EXTRUSION, MODIFIED	886288	89536	886288	2	B
MP 20, 21	ADHESIVE SIDE TRIM	698316	89536	698316	2	
MP 22,113	DECAL, CAUTION 240V	760926	89536	760926	2	
MP 23	DECAL, CAUTION 900V	760934	89536	760934	1	
MP 31- 44, 50- MP 53,131,132	WASHER, LOW THERMAL #8	859939 859939	89536	859939	20	
MP 45, 46	SIDE TRIM- INSERT MODIFIED	699082	89536	699082	2	A
MP 45, 46	SIDE TRIM- INSERT MODIFIED	886283	89536	886283	2	B
MP 47	INSULATOR, DIGITAL MOTHERBOARD	761247	89536	761247	1	
MP 54, 55	AIDE,PCB PULL	541730	89536	541730	2	
MP 106,107	WASHER,FLAT,STL,.191,.289,.010	111047		COMMERCIAL	2	
MP 108-110	FOOT,ADHESIVE,RUBBER,GREY,.44X.20	358341	[illegible]	SJ-5003	3	
MP 114	GROMMET,SLOT,RUBBER,.250,.437	853291	73734	113006	1	
W 1	CABLE WIDEBAND TO FRONT PANEL	[illegible]	89536	[illegible]	1	

NOTES.

⚡ Static sensitive part.

1. Non-repairable assembly.
A Used on S/N [illegible] and above.
B Used on S/N [illegible] and above.

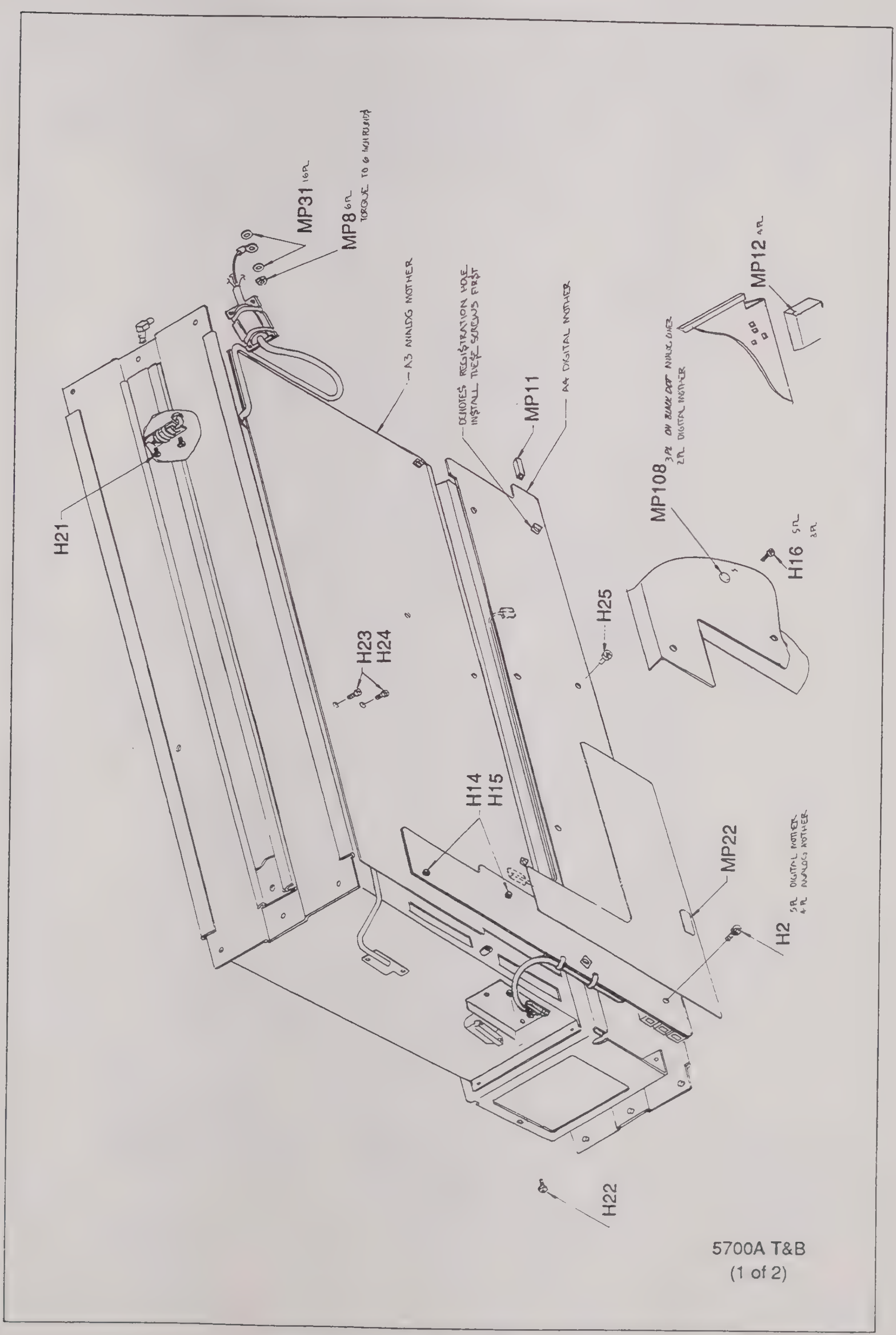

Figure 6-1a. Chassis Final Assembly

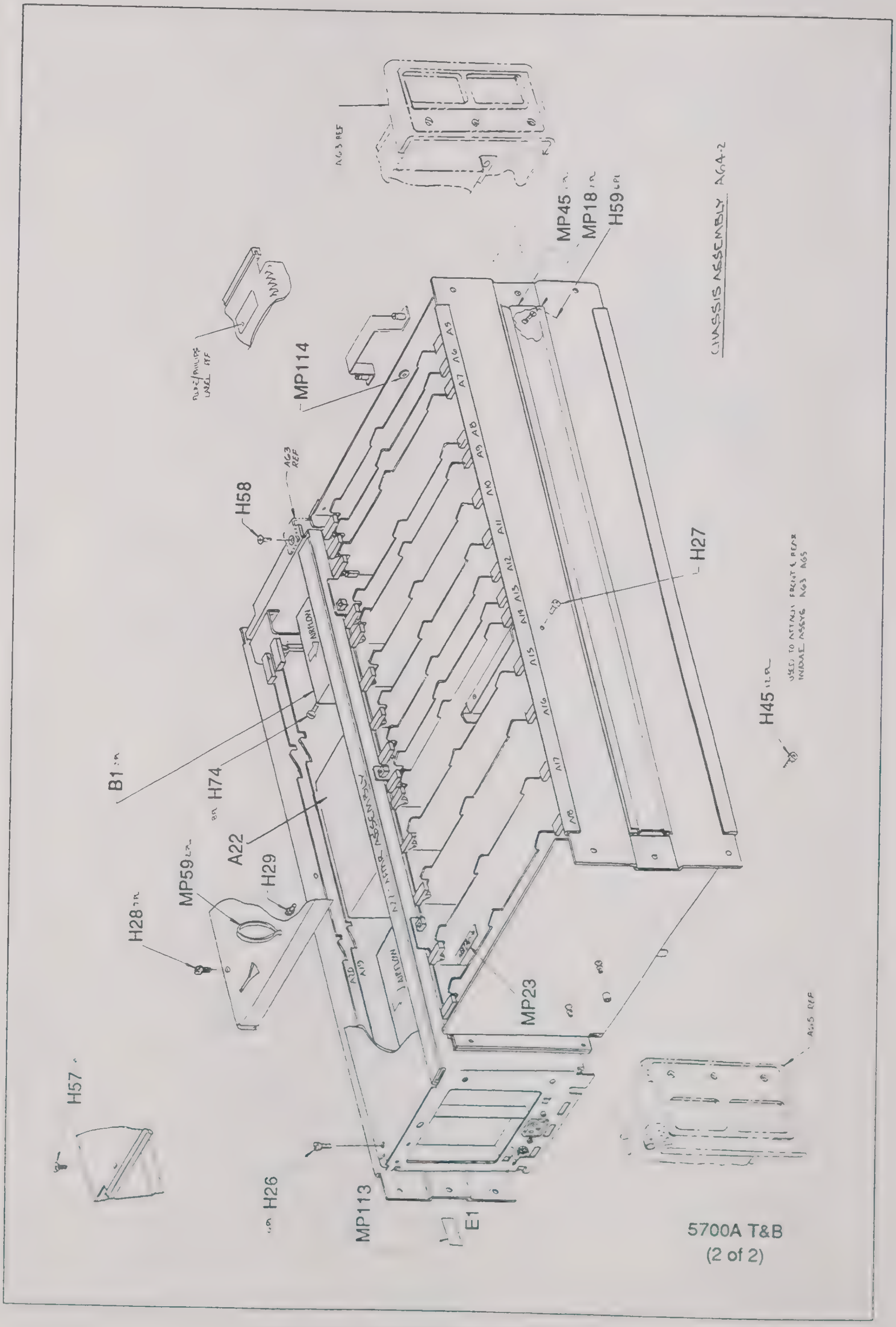

Figure 6-1a. Chassis Final Assembly (cont)

Table 6-1b. Rear Panel Final Assembly

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
F 1	FUSE,.25X1.25,1.25A,250V,SLOW	851936	71400	MDL-8-1-3-FLC	1	
H 1	FILTER, AIR	813493	89536	813493	1	
H 3- 6	SCREW,CAP,SCKT,SS,8-32,.375	837575		COMMERCIAL	4	
H 7- 12	SCREW,MACH,PH,P,STL,6-32X0.750	114223		COMMERCIAL	6	
H 13	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	1	
MP 1	PANEL, REAR	764464	89536	764464	1	A
MP 1	PANEL, REAR	886387	89536	886387	1	B
MP 2	GROMMET,NYLON,NAT,.056X.150X.100X.155	285254	03296	G51P-A	1	
MP 3	DECAL, REAR OUTPUT CABLE DIAGRAM	802975	89536	802975	1	A
MP 3	DECAL, REAR OUTPUT CABLE DIAGRAM	886291	89536	886291	1	B
MP 8, 9	WASHER,FLAT,STL,.160,.281,.010	111005		COMMERCIAL	2	
MP 11, 12	CONN ACC,MICRO-RIBBON,JACK SCREW	681940	02660	57-1912-01	2	
MP 13- 20	CONN ACC,D-SUB,JACK SCREW,4-40	448092	08718	D-20418-2	8	
MP 21	ALUMINUM REAR OUTPUT HOUSING	775809	89536	775809	1	A
MP 21	ALUMINUM REAR OUTPUT HOUSING	885462	89536	885462	1	B
MP 22	MOLDED HOUSING, REAR OUTPUT	775783	89536	775783	1	A
MP 22	MOLDED HOUSING, REAR OUTPUT	886358	89536	886358	1	B
MP 23	DECAL, REAR OUTPUT	813576	89536	813576	1	A
MP 23	DECAL, REAR OUTPUT	886296	89536	886296	1	B
MP 24	FILTER FRAME	775734	89536	775734	1	A
MP 24	FILTER FRAME	886390	89536	886390	1	B
MP 25- 30	NUT, #8 LOW THERMAL	850334	89536	850334	6	
MP 31, 32	HANDLE, INSTRUMENT	791897	89536	791897	2	A
MP 31, 32	HANDLE, INSTRUMENT	886333	89536	886333	2	B
MP 33, 34	BINDING POST-RED	850292	89536	850292	2	A
MP 33, 34	BINDING POST-RED	886382	89536	886382	2	B
MP 35, 36	BINDING POST, BLACK	850297	89536	850297	2	A
MP 35, 36	BINDING POST, BLACK	886379	89536	886379	2	B
MP 37	BINDING POST,BLUE	823203	89536	823203	1	A
MP 37	BINDING POST,BLUE	886366	89536	886366	1	B
MP 38	BINDING POST, PURPLE	850321	89536	850321	1	A
MP 38	BINDING POST, PURPLE	886361	89536	886361	1	B
MP 43- 50	WASHER,FLAT,SS,.119,.187,.010	853296		COMMERCIAL	8	
MP 51- 54	WASHER, LOW THERMAL	760892	89536	760892	4	
MP 55, 56	NUT, LOW THERMAL	760876	89536	760876	2	
W 1	CORD,LINE,5-15/IEC,3-18AWG,SVT	284174	70903	17239	1	
W 2	AC LINE FILTER ASSY	775445	89536	775445	1	
NOTES:	ϟ Static sensitive part. A. Used on S/N 5115000 and above. B. Used on S/N 5115001 and above.					

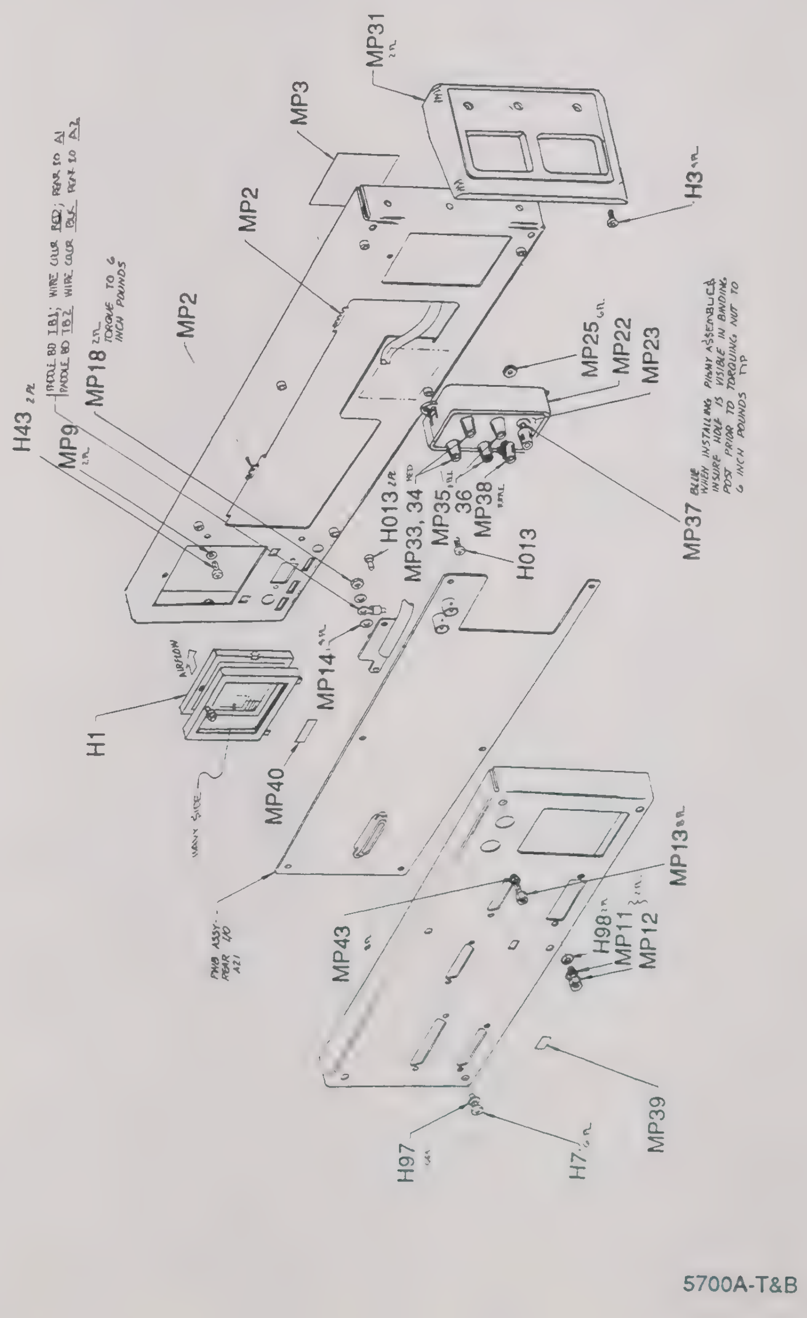

Figure 6-1b. Rear Panel Final Assembly

Table 6-2. A1 Keyboard PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
CR 1- 4	LED,GREEN,SUBMINIATURE,4 MCD	912241	26402	SSL-LXASS3GC	4	
DT 1, 2	ϟ ISOLATOR,OPTO,OPTICAL SWITCH,INFRARED	523530	09214	H22A1	2	
W 1	CABLE, KEYBOARD/REAR PANEL	802710	89536	802710	1	
NOTES:	ϟ Static sensitive part.					

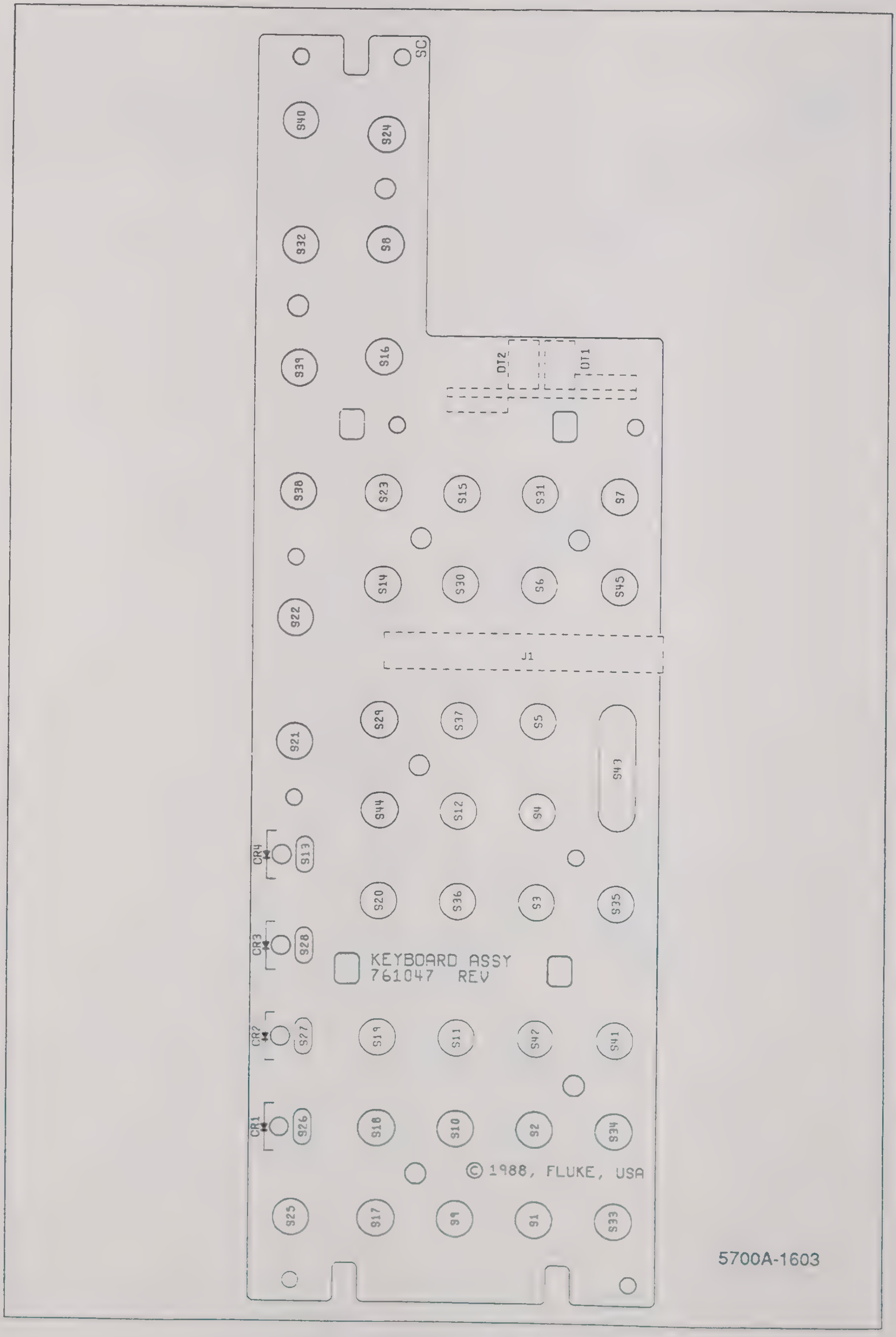

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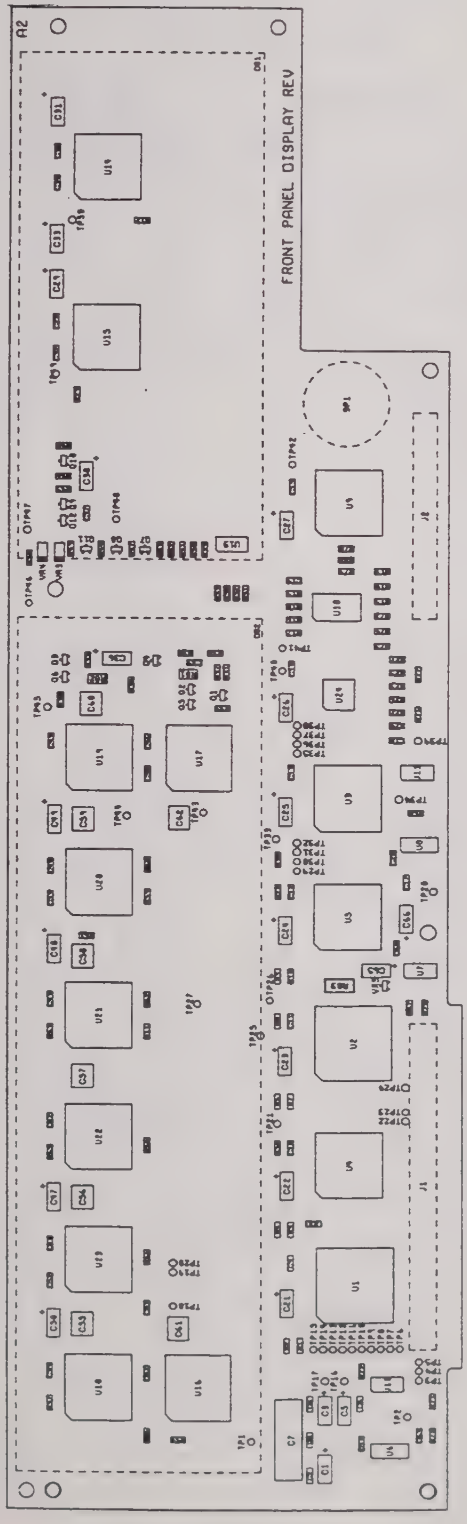
Figure 6-2. A1 Keyboard PCA

Table 6-3. A2 Front Panel PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,TA,47UF,+-20%,10V	746990	56289	195D476X0010H2B	1	
C 2, 4, 9- C 20, 28, 30, C 35, 37, 39- C 46, 64	CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287 747287 747287 747287	04222	12063C104KAT060R	27	
C 3, 21- 27, C 29, 31, 36, C 38, 47- 50, C 66	CAP,TA,10UF,+-20%,25V	772491 772491 772491 772491	56289	195D106X0025G2B	17	
C 5, 33, 65	CAP,TA,1.5UF,+-20%,50V	780478	56289	195D155X0050F2B	3	
C 6, 8, 32, C 34, 51- 54	CAP,CER,0.01UF,+-20%,100V,X7R,1206	742981 742981	04222	12061C103MA1050B	8	
C 7	CAP,AL,10UF,+-20%,100V,SOLV PROOF	820738	62643	KME100T10RM6X16LL	1	
C 55- 62	CAP,POLYES,0.68UF,+-20%,100V	912506	68919	MKS2684M100	8	
C 63	CAP,CER,100PF,+-10%,50V,COG,1206	740571	04222	12065A101KAT050R	1	
DS 1	TUBE, DISPLAY, VAC FLOR,2-ROW,22-CHAR	806976	0BW21	CP2215	1	
DS 2	TUBE,DISPLAY,VAC FLUOR, PATTERN DIS	832543	89536	832543	1	
J 2	HEADER,2 ROW,.100CTR,40 PIN	807453	59730	501-4027ES	1	
MP 1- 10	FOOT,ADHESIVE,RUBBER,BLACK,.50X.12	543488	28213	SJ5008	10	
Q 1- 4, 7- Q 10	⚡ TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23 ⚡	742023 742023	73445	BCX17TRL	8	
Q 5, 6, 11, Q 12	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23 ⚡	742031 742031	73445	BCX19TRL	4	
R 1, 3, 5, R 6, 8, 10- R 12, 20, 28- R 30, 55- 59, R 61, 63, 65, R 72, 76	⚡ RES,CERM,4.7K,+-5%,.125W,200PPM,1206 ⚡ ⚡ ⚡ ⚡ ⚡	740522 740522 740522 740522 740522 740522	59124	RM73B2BJ472B	22	
R 2, 4, 7, R 9, 40, 41, R 52, 53	⚡ RES,CERM,1.1K,+-5%,.125W,200PPM,1206 ⚡ ⚡	746008 746008 746008	09969	CRCW1206112JB02	8	
R 13- 15, 24, R 25, 70, 73- R 75	⚡ RES,CERM,39K,+-5%,.125W,200PPM,1206 ⚡ ⚡	746677 746677 746677	09969	CRC11206393JB02	9	
R 16- 19	⚡ RES,CERM,150,+-1%,.125W,100PPM,1206	772780	91637	CRCW1206151FB02	4	
R 22, 26, 37- R 39, 42, 49- R 51, 54	⚡ RES,CERM,6.8K,+-5%,.125W,200PPM,1206 ⚡ ⚡	746024 746024 746024	09969	CRCW1206682JB02	10	
R 23, 27, 71	⚡ RES,CERM,82K,+-5%,.125W,200PPM,1206	811794	59124	RM73B2BJ8202B	3	
R 31- 34, 43- R 46, 60, 62, R 64, 66	⚡ RES,CERM,1K,+-5%,.125W,200PPM,1206 ⚡ ⚡	745992 745992 745992	59124	RM73B2BJ102B	12	
R 35, 36, 68	⚡ RES,CERM,620,+-5%,.125W,200PPM,1206	745984	09969	CRCW1206621JB02	3	
R 47, 48	⚡ RES,CERM,453,+-1%,.125W,100PPM,1206	801415	91637	CRCW1206453FB02	2	
R 67	⚡ RES,CERM,200,+-5%,.125W,200PPM,1206	746339	59124	RM73B2BJ201B	1	
R 77	⚡ RES,CERM,91,+-5%,.125W,200PPM,1206	756338	59124	RM73B2BJ910B	1	
SP 1	AF TRANSD,PIEZO,24 MM	602490	51406	PKM24-4A1	1	
U 1, 2	⚡ IC,NMOS,1K X 8 DUAL PORT SRAM,PLCC	806653	34335	AM2130-10JC	2	
U 3	⚡ IC,CMOS,900 GATE PLD,5700A-90720,PLCC	838607	89536	838607	1	
U 4	⚡ IC,CMOS,900 GATE PLD,5700A-90721 PLCC	838615	89536	838615	1	
U 5	⚡ IC,CMOS,900 GATE PLD,5700A-90722,PLCC	845375	89536	845375	1	
U 6	⚡ IC,CMOS,14 STAGE BINARY COUNTER,SOIC	831081	04713	MC74HC4060DR1	1	
U 7	⚡ IC,COMPARATOR,DUAL,HIGH SPEED,SOIC	831271	18324	NE522DT	1	
U 8	⚡ IC,CMOS,12 STAGE BIN RIPPLE CNTR,SOIC	831636	18324	74HC4040DT	1	
U 9	⚡ IC,CMOS,900 GATE PLD,5700A-90723,PLCC	845383	89536	845383	1	
U 10	⚡ IC,LSTTL,OCTL D TRNSPRNT LATCHES,SOIC	742726	01295	SN74LS373DR	1	
U 11	⚡ IC,CMOS,HEX INVERTER,SOIC	742585	18324	N74HCT040	1	
U 12	⚡ IC,CMOS,DUAL D F/F,+EDG TRG,SOIC	782995	01295	SN74HC74DR	1	
U 13	⚡ IC,TTL,HEX INVERTER,W/OPEN COLL,SOIC	741249	18324	N7406DT	1	

Table 6-3. A2 Front Panel PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 14- 23	ϟ IC,BIMOS,DISPLAY DRIVER,80V,PLCC	741231	56289	UCN5818EP-1	10	
U 24	ϟ IC,CMOS,600 GATE PLD,5700A-90724,PLCC	837369	89536	837369	1	
VR 1, 2	ϟ ZENER,UNCOMP,3.9V,10%,64.0MA,1.0W,MLF	742015	04713	MLL4703T1	2	
VR 3, 4	ϟ ZENER,UNCOMP,6.8V,10%,37MA,1W,MLF	806927	04713	MLL4736T1	2	
VR 5	ϟ ZENER,UNCOMP,6.8V,5%,20MA,350MW,SOT23	837195	04713	MMBZ5235BT1	1	
W 1	CABLE, MOTHERBOARD TO DISPLAY	791640	89536	791640	1	
NOTES:	ϟ Static sensitive part.					



5700A-1602

Figure 6-3. A2 Front Panel PCA

Table 6-4. A3 Analog Motherboard PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,POLYES,0.1UF,+-10%,50V	649913	60935	185-2/0.1/K/0050/RAB	1	
C 2	CAP,CER,1000PF,+-20%,50V,X7R	697458	89536	697458	1	
C 3	CAP,TA,1UF,+-20%,35V	697417	56289	199D105X0035AA1	1	
C 4	CAP,TA,4.7UF,+-20%,25V	807644	56289	199D475X0025BA1	1	
C 5	CAP,POLYES,0.47UF,+-10%,50V	697409	60935	185-2/0.47K0050RAB	1	
CR 1, 2	⚡ DIODE,SI,BV=75V,IO=150MA,500MW	203323	07910	1N4448	2	
H 1, 2	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	2	
H 3- 5	CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	172080	06383	SST-1M	3	
J 71	FIBER OPTIC,RECEIVER,1MBD	822148	28480	HFBR-2522	1	
J 72	FIBER OPTIC,TRANSMITTER,1MBD	822155	28480	HFBR-1521/1522	1	
J 101,111,201, J 202,211,212, J 301,302,311, J 312,401,402, J 501,502,511, J 512,601,602, J 611,612,701, J 702,801,802, J 901,902	CONN,DIN41612,TYPE C,64 SCKT	807818 807818 807818 807818 807818 807818 807818 807818 807818	28213	7364-60D3TB	26	
J 811,812,821, J 822	SOCKET,1 ROW,PWB,.156CTR,10 POS	851183 851183	27264	26-01-1108	4	
K 1- 3	RELAY,ARMATURE,2 FORM C,4.5VDC	783746	77342	R10-E6297-3	3	
K 4, 5, 9, K 10	RELAY,REED,1 FORM A,5VDC	806950 806950	71707	7003-5065	4	
K 6- 8, 11	RELAY,ARMATURE,2 FORM C,5V	733063	33297	MR602-5SR	4	
K 12	RELAY,REED,1 FORM B,5VDC	845164	71707	7004-5071	1	
K 13	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VH284	1	
MP 3- 54	RIVET,S-TUB,OVAL,STL,.087,.250	838482		COMMERCIAL	52	
MP 55, 56	SPACER,BROACH,RND,STL,6-32,.375	414508	24347	KFE-632-12-ZC	2	
MP 57- 61	INSERT.STANDOFF,BROACH,SNAP-TOP,0.250	820613	24347	KSSA-156-8	5	
MP 62- 66	CLAMP,CABLE,ADHESIVE,NYLON,.125	854273	06915	HUC-2	5	
MP 101-128	CONN ACC,DIN41612,KEY	832733	28213	3435-1	28	
R 1	RES,CF,75,+-5%,0.25W	441642	59124	CF1-4750JB	1	
R 2	RES,CF,91,+-5%,0.25W	441683	59124	CF1-4910J	1	
RV 1	VARISTOR,22V,+-20%,1.0MA	500777	89536	500777	1	
W 1	CABLE, FRONT/REAR	802835	89536	802835	1	
W 2	CABLE ASSY, MOTHERBOARD BUS, FRONT	859926	89536	859926	1	
W 3	CABLE ASSY, MOTHERBOARD BUS, REAR	859934	89536	859934	1	
W 8	CABLE, KEYBOARD/REAR PANEL	802710	89536	802710	1	
W 11	CABLE, BOOST	802744	89536	802744	1	
XK 1- 3	RELAY SOCKET,4 POLE	441964	77342	27E606	3	
NOTES:	⚡ Static sensitive part.					

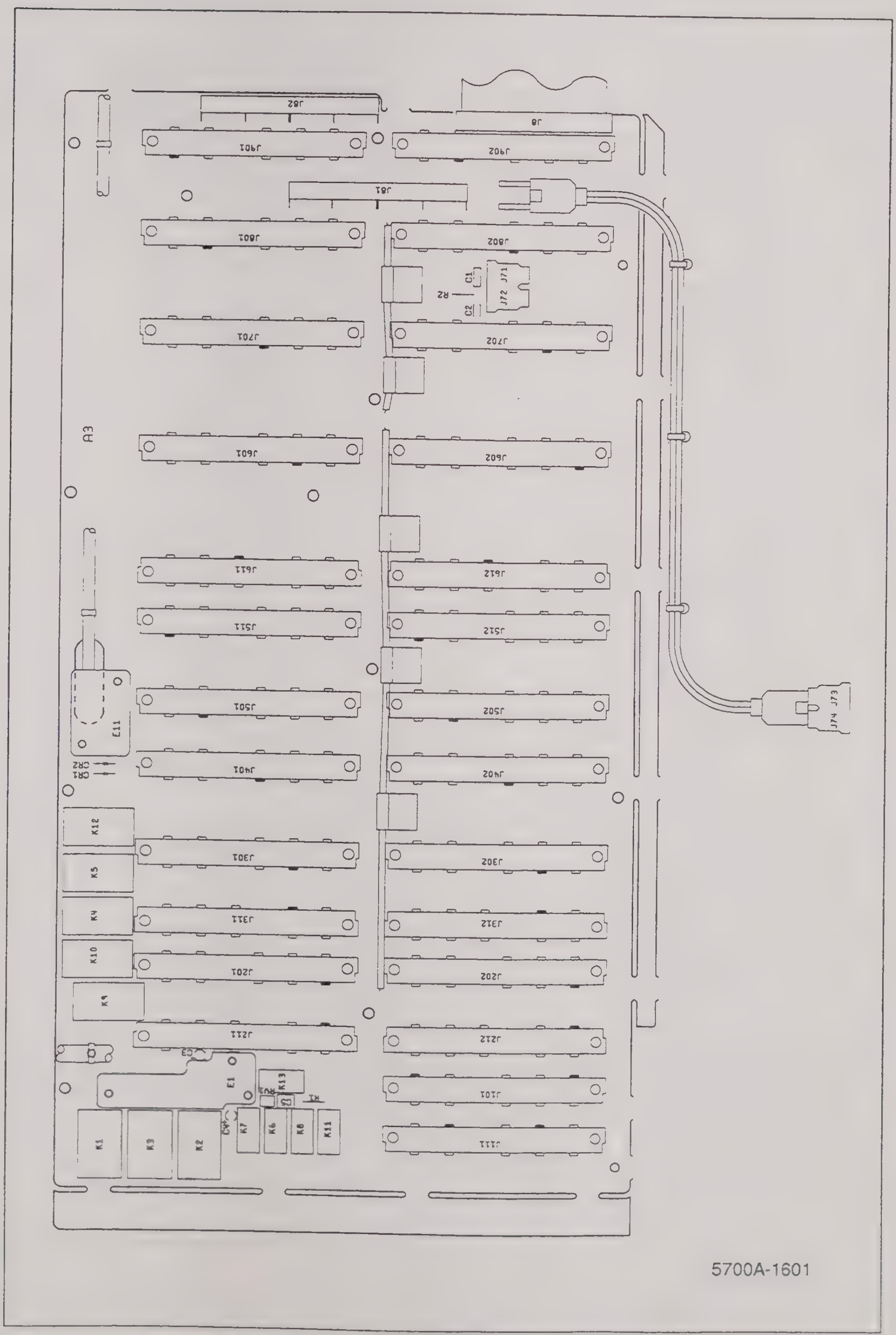


Figure 6-4. A3 Analog Motherboard PCA

Table 6-5. A4 Digital Motherboard PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 4	CAP,TA,10UF,+-20%,35V	816512	56289	199D106X9035DA1	2	
C 2	CAP,CER,1000PF,+-20%,50V,X7R	697458	89536	697458	1	
C 3	CAP,POLYES,0.1UF,+-10%,50V	649913	60935	185-2/0.1/K/0050/RAB	1	
C 5	CAP,POLYES,0.1UF,+-20%,250VAC	542233	60935	158.00-0.10UF-250VAC	1	
C 6	CAP,CER,6800PF,+-5%,100V,C0G	816710	04222	SR211A682JAA	1	
CR 3, 4	DIODE,SI,100 PIV,1.0 AMP	698555	04713	IN4002RL	2	
F 1	FUSE,.25X1.25,3A,250V,SLOW	109280	71400	MDL-3	1	1
H 8- 14	CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	172080	06383	SST-1M	7	
H 19, 20	SCREW,MACH,PH,P,STL,M3X6	149567		COMMERCIAL	2	
H 21, 22	WASHER,FLAT,STL,.093,.219,.020	306415		COMMERCIAL	2	
J 11	HEADER,1 ROW,.156CTR,12 PIN	831354	00779	1-640388-2	1	
J 13	HEADER,1 ROW,.156CTR,10 PIN	446724	00779	1-640388-0	1	
J 14	HEADER,1 ROW,.156CTR,16 PIN	831370	00779	1-640388-6	1	
J 15	HEADER,1 ROW,.156CTR,14 PIN	831362	00779	1-640388-4	1	
J 16	HEADER,1 ROW,.156CTR,8 PIN	385435	00779	1-640388-8	1	
J 21	CONN,DIN41612,TYPE C,RT ANG,64 PIN	853437	00779	533205-2	1	
J 31	HEADER,1 ROW,.156CTR,RT ANG,5 PIN	844717	27264	26-48-1056	1	
J 41	CONN,DIN41612,TYPE C,64 SCKT	853853	88245	96S-6033-0531-2-C	1	
J 51, 52	HEADER,1 ROW,.100CTR,3 PIN	845334	00779	640456-3	2	
J 61, 62	CONN,DIN41612,TYPE C,64 SCKT	807818	28213	7364-60D3TB	2	
J 73	FIBER OPTIC,TRANSMITTER,1MBD	822155	28480	HFBR-1521/1522	1	
J 74	FIBER OPTIC,RECEIVER,1MBD	822148	28480	HFBR-2522	1	
J 91	HEADER,2 ROW,.100CTR,34 PIN	851696	59730	501-3437ES	1	
MP 1	HLDR PART,FUSE,BODY,PWB MT	602763	61935	FAU031.3573	1	
MP 2	HLDR PART,FUSE,CAP,1/4X1-1/4	460238	61935	031.1666	1	
MP 3- 12	RIVET,S-TUB,OVAL,STL,.087,.250	838482		COMMERCIAL	10	
MP 16	BRACKET, POWER SWITCH	885710	89536	885710	1	
MP 17, 18, 20	SPACER,SWAGED,RND,BR,.177ID,.093	837864	55566	3076C177B16M0DL=.093	3	
MP 21	SWITCH PART,FLEX LINKAGE,396MM	836478	7Z884	SWWR-S-001	1	
MP 22, 23	FOOT,ADHESIVE,RUBBER,GREY,.44X.20	358341	28213	SJ-5003	2	
MP 24, 25, 26	SPACER,BROACH,SNAP,AL,.187	820639	46384	YA7-6359	3	
P 81, 82	HEADER,1 ROW,.156CTR,20 PIN	831222	55322	SEP10825-02	2	
R 1	RES,CF,91,+-5%,0.25W	441683	80031	1-4-5P91E	1	
R 2, 3	RES,WW,2,+-1%, .7W	255646	54343	UT-1A	2	
R 4	RES,CF,68,+-5%,0.25W	414532	59124	CF1-4680J	1	
RV 1	VARISTOR,22V,+-20%,1.0MA	500777	89536	500777	1	
RV 2	VARISTOR,430V,+-10%,1.0MA	519355	09214	V275LA15AS14K275	1	
SW 1	SWITCH PART,SWITCH,DPST	886697	31918	FN01NEETBN4101BAG	1	
SW 2- 4	SWITCH,SLIDE,DPDT,LINE SELECT,RT ANG	817353	10389	18-514-0003W/WHITEDOT	3	
W 18	CABLE, FIBER OPTIC	802769	89536	802769	1	
W 90	CABLE, REAR PANEL-CPU	802728	89536	802728	1	
NOTES:	ϟ Static sensitive part. 1. Fuse PN 109280 is for 100-120 volt configuration. For 200-230 volt configuration order PN 109281.					

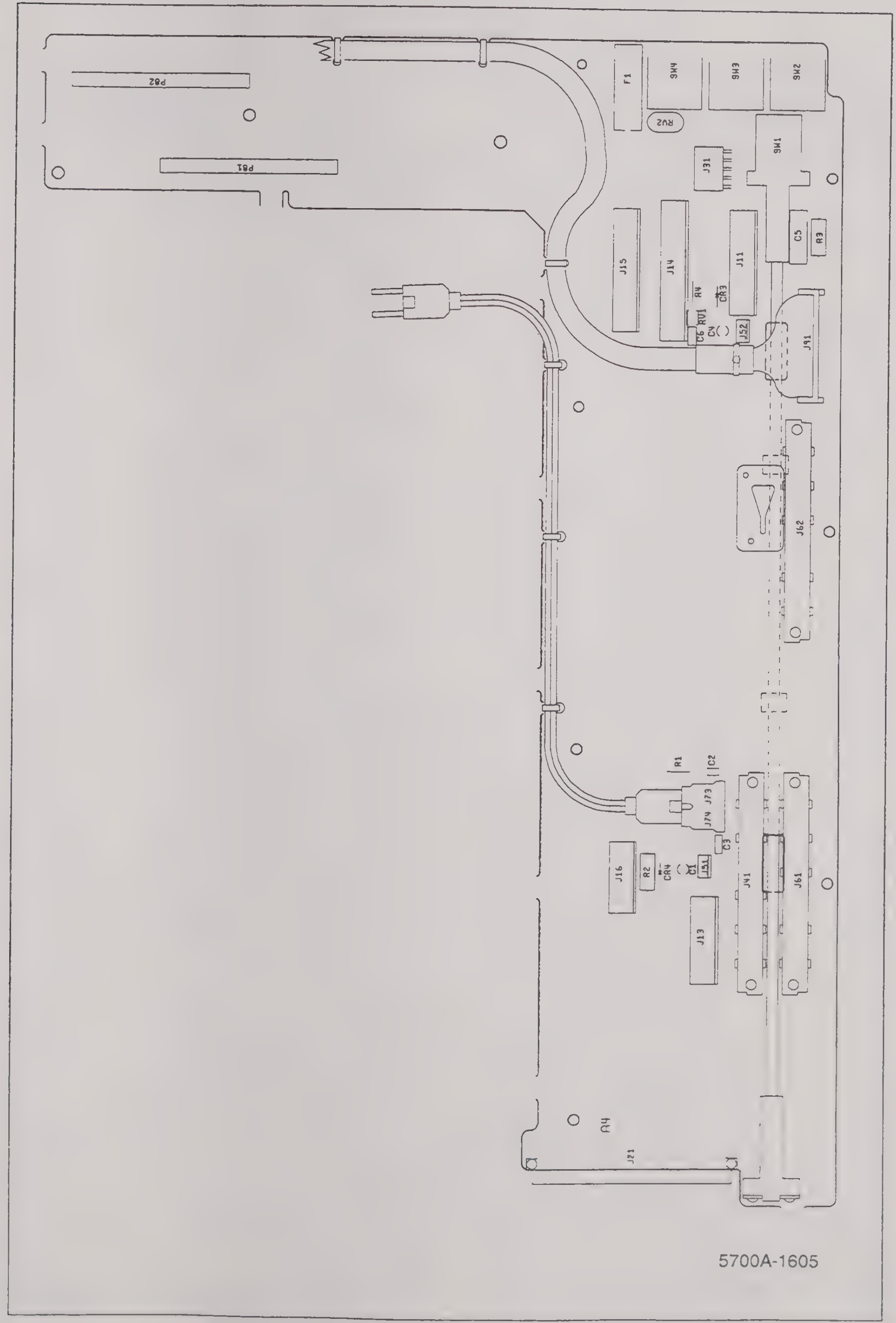


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Figure 6-5. A4 Digital Motherboard PCA

Table 6-6. A5 Wideband Output PCA, Option -03

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,CER,4.7PF,+-0.25PF,50V,C0G	721837	51406	RPE122C0G479K50V	1	
C 2	CAP,CER,22PF,+-2%,50V,C0G	714832	04222	SR595A220GAT	1	
C 3	CAP,POLYES,0.047UF,+-10%,50V	820548	60935	185-2/473K0050RAB	1	
C 4, 11- 13, C 66	CAP,CER,100PF,+-5%,50V,C0G	831495 831495	04222	SR225A101JAT	5	
C 5	CAP,CER,470PF,+-10%,50V,C0G	733071	04222	SR215A471KAT	1	
C 6, 52, 53, C 79	CAP,POLYES,0.033UF,+-10%,50V	715276 715276	60935	185-2/333K0050RAB	4	
C 7, 10, 15, C 23, 81	CAP,POLYES,0.47UF,+-10%,50V	697409 697409	84411	J1320R47MF10PCT50V	5	
C 8, 9, 25, C 27- 29, 33- C 37, 45- 51, C 55- 63, 72- C 76, 80	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913 649913	60935	185-2/0.1K0050RAB	33	
C 14	CAP,POLYES,0.22UF,+-5%,50V	747519	60935	185.22/J0050RCB	1	
C 16- 18, 21, C 26, 39- 44	CAP,TA,4.7UF,+-20%,25V	807644 807644	56289	199D475X0025BA1	11	
C 19, 77, 78	CAP,POLYES,0.001UF,+-10%,50V	720938	60935	185/.001K0050RAB	3	
C 20, 22	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 38	CAP,CER,5.6PF,+-0.25PF,100V,C0H	512954	51406	RPE110COG5R6C1	1	
C 64, 65	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	2	
C 67	CAP,CER,33PF,+-2%,50V,C0G	715292	04222	SR215A330GAT	1	
C 68	CAP,CER,18PF,+-2%,100V,C0G	830638	04222	SR211A180GAT	1	
C 82	CAP,AL,47UF,+-20%,16V,SOLV PROOF	643304	62643	LR16VB470M6X0LLV	1	
C 83	CAP,CER,270PF,+-5%,50V,C0G	658898	04222	SR215A271JAT	1	
CP 1	ADAPTER,BNC(F),BANANA PLUG(M)	528802	05276	1269	1	
CP 2	ADAPTOR,COAX,BNC(M),N(F)	756775	91836	KN-9409	1	
CR 1- 4, 6, CR 7	ϟ DIODE,SI,BV= 75.0V,RADIAL INSERTED ϟ	659516 659516	03508	1N4448	6	
CR 5	ϟ DIODE,SI,N-JFET,CURRENT REG,IF=5.3 MA	852116	17856	J9010-TR3	1	
E 3	JUMPER,REC,2 POS,.100CTR,.025 SQ POST	757294	00779	850108-1	1	
H 7- 9	SCREW,MACH,PH,P,STL,6-32,.500	152173		COMMERCIAL	4	
H 10- 19	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	10	
J 1, 2	CONN,COAX,SMB(M),PWB,RT ANG	353243	98291	051-053-0000-220	2	
J 3	HEADER,1 ROW,.100CTR,2 PIN	643916	22526	65500-102	1	
K 1, 11	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	2	
K 2, 3, 9, K 10, 12	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307 769307	61529	DS2EML2DC5VH284	5	
K 4- 8	RELAY,ARMATURE,2 FORM C,5VDC	806810	11532	432-7478	5	
L 1- 6, 18	CHOKE,6TURN	320911	89536	320911	7	
L 19	INDUCTOR,100UH,+-10%,12MHZ,SHLD	249102	24759	MR-100	1	
L 20- 22	INDUCTOR,220UH,+-5%,9.4MHZ,SHLD	147835	24759	MR-220	3	
L 23- 25	CORE,TOROID,FERRITE,.047X.138X.118	321182	02114	56-590-65-4B	3	
M 2	SHIELD, WIDEBAND OUTPUT, REAR	764498	89536	764498	1	
M 3	SHIELD, WIDEBAND AMP, FRONT	775643	89536	775643	1	
M 4	SHIELD, WB OUTPUT, ATTENUATOR, REAR	775650	89536	775650	1	
M 5	SHIELD, WB OUTPUT, ATTENUATOR, FRONT	775668	89536	775668	1	
MP 1	TERMINATION,COAX,N(M),N(F),50 OHM	853429	0GZV8	6701.17.A	1	
MP 2, 3	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	2	
MP 4, 9	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 6, 25- 34	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	11	
MP 10- 14	RELAY WASHER	803247	89536	803247	5	
MP 15- 24	HEAT DIS,PRESS ON,TO-5	418384	13103	2228B	10	
P 111	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TE	1	
Q 1	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	698241	04713	2N4401RLRA1	1	

Table 6-6. A5 Wideband Output PCA, Option -03 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Q 2, 3	⚡ TRANSISTOR,SI,N-DMOS FET,TO-72	394122	18324	SD210EE	2	
Q 4- 6	⚡ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	659417	04713	BFR96	3	
Q 7, 8	⚡ TRANSISTOR,SI,PNP,SMALL SIG,RF,TO-39	800201	04713	2N5583	2	
Q 9, 10, 14- Q 16	⚡ TRANSISTOR,SI,NPN,HI-FREQ,TO-39 ⚡	912522 912522	04713	MRF544	5	
Q 11- 13	⚡ TRANSISTOR,SI,PNP,70V,400MA,TO-39	866769	04713	MRF545	3	
Q 17	⚡ TRANSISTOR,SI,N-JFET,TO-92	816314	17856	J2864TR	1	
Q 18	⚡ TRANSISTOR,SI,N-DMOS PWR FET,TO-92	782565	59640	VN0104N3	1	
R 1	RES,MF,866,+-1%,0.125W,50PPM	320390	91637	CMF558660F T-1	1	
R 2	RES,MF,200,+-1%,0.125W,100PPM	245340	91637	CMF552000F T-1	1	
R 3	RES,MF,412K,+-1%,0.125W,50PPM	714287	59124	MF50CVT4123F	1	
R 7, 8	RES,MF,698K,+-1%,0.125W,100PPM	757252	59124	MF50DVT6983F	2	
R 9, 24, 27, R 42,102	RES,CF,20K,+-5%,0.25W	697110 697110	59124	CF1-4VT203JB	5	
R 10	RES,CF,3M,+-5%,0.25W	746172	59124	CF1-4VT305J	1	
R 11	RES,MF,20.5K,+-1%,0.125W,100PPM	655233	59124	MF50DVT2052F	1	
R 12,111-113	RES,CF,2K,+-5%,0.25W	810457	59124	CF1-4VT202J	4	
R 13	RES,MF,14.3K,+-1%,0.125W,100PPM	721803	59124	MF50DVT1432F	1	
R 14, 28,114	RES,MF,10K,+-1%,0.125W,100PPM	658914	59124	MF50DVT1002F	3	
R 15, 38	RES,CF,3K,+-5%,0.25W	810366	59124	CF1-4VT302J	2	
R 16	RES,CF,620,+-5%,0.25W	810408	59124	CF1-4VT621J	1	
R 17	RES,MF,866,+-1%,0.125W,50PPM	816603	59124	MF50CVT8660F	1	
R 18	RES,MF,200,+-1%,0.125W,100PPM	820282	59124	MF50DVT2000F	1	
R 19	RES,CF,12K,+-5%,0.25W	757799	59124	CF1-4VT123J	1	
R 20, 31	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	2	
R 21,104	RES,MF,10.5K,+-1%,0.125W,100PPM	816611	59124	MF50DVT1052F	2	
R 22, 35	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	2	
R 23	RES,CF,1M,+-5%,0.25W	649970	59124	CF1-4VT105J	1	
R 25	RES,MF,205K,+-1%,0.125W,100PPM	706234	59124	MF50DVT2053F	1	
R 26	RES,CF,43K,+-5%,0.25W	821777	59124	CF1-4VT433J	1	
R 29,121	RES,MF,56.2K,+-1%,0.125W,100PPM	706242	59124	MF50DVT5622F	2	
R 30,103,105, R 106	RES,CF,150K,+-5%,0.25W	758219 758219	59124	CF1-4VT154J	4	
R 32, 63	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4VT103J	2	
R 33	RES,CF,22K,+-5%,0.25W	747535	59124	CF1-4VT223J	1	
R 34	RES,CF,24K,+-5%,0.25W	697599	59124	CF1-4VT243J	1	
R 36, 40, 45, R 62	RES,CF,1K,+-5%,0.25W	780585 780585	59124	CF1-4VT102J	4	
R 37	RES,MF,210,+-1%,0.125W,100PPM	327999	91637	CMF552100F T-1	1	
R 39	RES,CF,16K,+-5%,0.25W	714303	59124	CF1-4VT163J	1	
R 41	RES,CF,180K,+-5%,0.25W	573626	59124	CF1-4181J	1	
R 43, 44	RES,MF,100,+-0.1%,0.125W,25PPM	357400	91637	CMF551000B T-9	2	
R 46	RES,MF,1.74K,+-1%,0.125W,100PPM	344358	91637	CMF551741F T-1	1	
R 47	RES,MF,1K,+-1%,0.125W,100PPM	719468	91637	CMF551001F T-1	1	
R 48, 49, 51, R 55, 61, 65, R 71, 76, 77, R 84, 85, 90, R 91	RES,CF,51,+-5%,0.25W	572990 572990 572990 572990 572990	59124	CF1-4510JB	13	
R 50	RES,MF,499,+-1%,0.125W,100PPM	816462	91637	CMF554990F T-1	1	
R 52	RES,MF,150,+-1%,0.125W,100PPM	719674	91637	CMF551500F T-1	1	
R 53	RES,MF,402,+-1%,0.125W,100PPM	720201	91637	CMF554020F T-1	1	
R 54	RES,MF,576,+-1%,0.125W,100PPM	294843	91637	CMF555760F T-1	1	
R 56, 57	RES,MF,80.6,+-1%,0.5W,100PPM	158790	91637	CMF6580R6F T-1	2	
R 58, 59	RES,MF,75,+-1%,0.5W,100PPM	150870	91637	CMF6575R0F T-1	2	

Table 6-6. A5 Wideband Output PCA, Option -03 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 64	RES,MF,806,+-1%,0.6W,50PPM	851944	91637	CPF-18060F T-2	1	
R 66	RES,MF,49.9,+-1%,0.125W,100PPM	720318	59124	CMF5549R9F T-1	1	
R 67, 68	RES,MF,21,+-1%,0.125W,100PPM	296632	91637	CMF5521R0F T-1	2	
R 69, 70	RES,MF,249,+-1%,0.5W,100PPM	241281	91637	CMF652490F T-1	2	
R 72, 73	RES,MF,909,+-1%,0.5W,100PPM	178053	91637	CMF659090F T-1	2	
R 74	RES,CF,20K,+-5%,0.25W	573444	59124	CF1-4203J	1	
R 75	RES,MF,10K,+-1%,0.125W,100PPM	719476	91637	CMF551002F T-1	1	
R 78, 79, 86- R 89	RES,MF,12.7,+-1%,0.125W,100PPM	441766 441766	91637	CMF5512R7F T-1	6	
R 80- 83	RES,MF,909,+-1%,0.5W,100PPM	178053	91637	CMF659090F T-1	4	
R 92- 95	RES,MF,75,+-1%,0.125W,100PPM	306027	91637	CMF5575R0F T-1	4	
R 96- 99	RES,MF,187,+-0.1%,0.5W,25PPM	807750	91637	CMF651870B T-9	4	
R 100	RES,MF,1.21K,+-1%,0.125W,100PPM	719559	91637	CMF551211F T-1	1	
R 101	RES,MF,1.43K,+-1%,0.125W,25PPM	447995	91637	CMF551431F T-9	1	
R 107	RES,CF,100,+-5%,0.25W	810465	59124	CF1-4VT101J	1	
R 108	RES,MF,49.9,+-1%,0.125W,100PPM	820266	59124	MF50DVT4992F	1	
R 109	RES,MF,2.15K,+-1%,0.125W,50PPM	347039	91637	CMF552151F T-1	1	
R 110	RES,MF,1K,+-0.1%,0.125W,25PPM	340380	91637	CMF551001B T-9	1	
R 115	RES,CF,200K,+-5%,0.25W	573634	59124	CF1-4204JB	1	
R 116	RES,MF,2K,+-1%,0.125W,100PPM	816629	59124	MF50DVT2001F	1	
R 117	RES,MF,1.69K,+-1%,0.125W,100PPM	321414	91637	CMF551691F T-1	1	
R 118	RES,CF,1.5K,+-5%,0.25W	810432	59124	CF1-4VT152J	1	
R 119	RES,MF,8.06K,+-1%,0.125W,100PPM	817619	59124	MF50DVT8061F	1	
R 120	RES,MF,124,+-1%,0.125W,100PPM	343905	91637	CMF551240F T-1	1	
R 122	RES,MF,4.99K,+-1%,0.125W,100PPM	721548	59124	MF55D4991F	1	
R 123-128	RES,CF,10,+-5%,0.25W	807669	59124	CF1-4VT100J	6	
TP 1- 19	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	19	
U 1	⚡ RMS CONVERTER TESTED 400 OHM-B GRADE	767707	89536	767707	1	
U 2, 11, 12	⚡ IC,OP AMP,DUAL,LO OFFST VOLT,LO-DRIFT	851704	27014	LF412ACN	3	
U 3	⚡ IC,ARRAY,5 TRANS,NPN,3 ISO,2 DIFF CON	248906	04713	MC3346P	1	
U 4	⚡ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 5	⚡ IC,OP AMP,LO-OFFSET VOLTAGE,LO-NOISE	605980	06665	OP-07DP	1	
U 6	⚡ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	1	
U 7	⚡ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 8	⚡ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
U 9, 10	⚡ IC,BIMOS,4 CHNL HI-VOLT DRVR W/LATCH	820514	56289	UCN-5800A	2	
VR 1	⚡ ZENER,UNCOMP,9.1V,5%,5MA,0.350W	853788	04713	1N5239BRR1	1	
VR 2	⚡ ZENER,COMP, 6.4V, 2%, 2 PPM TC, 1.0MA	419036	04713	SZG20287	1	
VR 3	⚡ ZENER,UNCOMP,16.0V,5%,15.5MA,1.0W	313221	04713	1N4745ARL	1	
VR 4	⚡ ZENER,UNCOMP,5.6V,5%,20MA,0.5W	820464	04713	1N5232BRR1	1	
W 1	CABLE, WIDEBAND OUTPUT INTERCONNECT	802876	89536	802876	1	
W 2	CABLE ASSY,50 OHM,COAX,N(M),3FT	853432	0GZV8	RG58C/U.36IN,2X1INL-50	1	
Z 1	⚡ RES,NET,THK F, 10DB/20DB ATTENUATOR	760728	89536	760728	1	
Z 2	⚡ RES,NET,THK F, 20DB/20DB ATTENUATOR	760769	89536	760769	1	
NOTES:	⚡ Static sensitive part.					

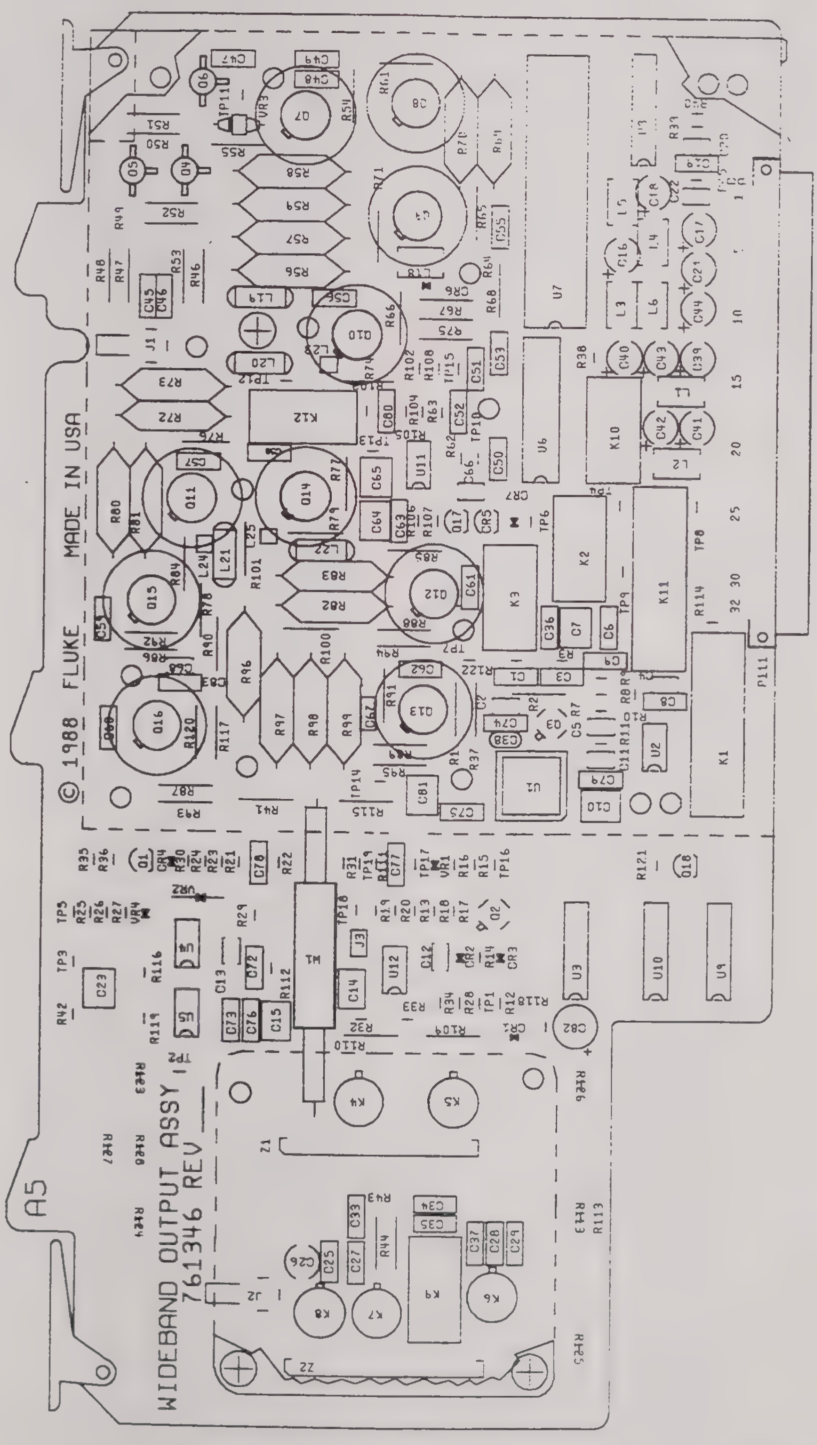

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Figure 6-6. A5 Wideband Output PCA, Option -03

Table 6-7. A6 Wideband Oscillator PCA, Option -03

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 8, 49- C 51	CAP,TA,4.7UF,+-20%,25V	807644 807644	56289	199D475X0025BA1	11	
C 9, 10	CAP,CER,2700PF,+-5%,50V,COG	832303	04222	SR595A272JAT	2	
C 11	CAP,CER,15PF,+-20%,50V,COG	697524	04222	SR215A150MAT	1	
C 12, 15, 16, C 18- 25, 29- C 33, 35- 48, C 52, 57, 58, C 60, 61,101, C 103,105-107, C 201,203,205- C 207,301,303, C 305-307,401, C 403,405-407, C 501,503,505- C 507	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913 649913 649913 649913 649913 649913 649913 649913 649913	60935	185-2/0.1K0050RAB	60	
C 13, 14	CAP,CER,0.047UF,+-10%,100V,X7R	844733	04222	SR591C473KAATR1A	2	
C 17	CAP,POLYES,0.22UF,+-10%,50V	706028	60935	185-2/.22K0050RCB	1	
C 26- 28	CAP,CER,0.01UF,+-10%,100V,X7R	557587	04222	SR21C103MAT	3	
C 34,209-212	CAP,CER,82PF,+-2%,50V,COG	714857	04222	SR595A820GAT	5	
C 53	CAP,CER,6800PF,+-5%,50V,COG	542894	04222	SR215A682JAT	1	
C 54, 55,102, C 108,202,208, C 302,308,402, C 408,502,508	CAP,POLYES,0.001UF,+-10%,50V	720938 720938 720938 720938	60935	185/.001/K0050RAB	12	
C 56, 59	CAP,CER,33PF,+-5%,50V,COG	714543	04222	SR215A330JAT	2	
C 62,409-412	CAP,CER,390PF,+-2%,50V,COG	820530	04222	SR215A391GAT	5	
C 109-112	CAP,CER,47PF,+-2%,100V,COG	832295	04222	SR211A470GAT	4	
C 309-312	CAP,CER,180PF,+-2%,50V,COG	820522	04222	SR215A181GAT	4	
C 509-512	CAP,CER,820PF,+-2%,50V,COG	631002	04222	SR215A821GAT	4	
CR 1, 2	DIODE,SILICON,VARACTOR,PIV= 28V	598078	04713	MVAM125	2	
CR 3- 9,101, CR 201,301,401, CR 501	ϟ DIODE,SI,BV= 75.0V,RADIAL INSERTED ϟ ϟ	659516 659516 659516	03508	1N4448	12	
CR 102,103,202, CR 203,302,303, CR 402,403,502, CR 503	ϟ DIODE,SI,SWICHING,PIN ϟ ϟ ϟ	334227 334227 334227 334227	96341	MA4P473	10	
E 2- 5	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	16	
E 6	JUMPER,REC,2 POS,.100CTR,.025 SQ POST	757294	00779	850108-1	1	
H 1- 5	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	5	
H 10	SCREW,PH,P,LOCK,SS,6-32X0.750	376822	74594	376822	1	
J 1	CONN,COAX,SMB(M),PWB,RT ANG	353243	98291	051-053-0000-220	1	
J 6	HEADER,1 ROW,.100CTR,2 PIN	643916	22526	65500-102	1	
L 1- 4, 7- L 12, 14, 15	CHOKE,6TURN	320911 320911	89536	320911	12	
L 5	INDUCTOR,0.18UH,+-10%,400MHZ,SHLD	249060	24759	MR-0.18	1	
L 6	INDUCTOR,1500UH,+-5%,2.5MHZ,SHLD	806505	24759	MR-1500	1	
L 16,102,104	INDUCTOR,1UH,+-5%,156MHZ,SHLD	806562	24759	MR-1	3	
L 101,503	INDUCTOR,22UH,+-10%,38MHZ,SHLD	147843	24759	MR-22	2	
L 103	INDUCTOR,1.5UH,+-5%,128MHZ,SHLD	413856	89536	413856	1	
L 201	INDUCTOR,33UH,+-10%,33MHZ,SHLD	249086	24759	MR-33	1	
L 202,204	INDUCTOR,2.2UH,+-5%,108MHZ,SHLD	806547	24759	MR-2.2	2	
L 203	INDUCTOR,3.3UH,+-10%,88MHZ,SHLD	174714	24759	MR-3.3	1	
L 301	INDUCTOR,82UH,+-10%,14MHZ,SHLD	542290	24759	MR-82	1	
L 302,304	INDUCTOR,3.9UH,+-5%,84MHZ,SHLD	413864	24759	MR-3.9	2	
L 303	INDUCTOR,5.6UH,+-10%,69MHZ,SHLD	598219	24759	MR-5.6	1	
L 401	INDUCTOR,120UH,+-5%,11.2MHZ,SHLD	321042	24759	MR-120	1	
L 402,404	INDUCTOR,8.2UH,+-5%,58MHZ,SHLD	806521	24759	MR-8.2	2	
L 403	INDUCTOR,12UH,+-5%,47MHZ,SHLD	[illegible]	24759	MR-12	1	

Table 6-7. A6 Wideband Oscillator PCA, Option -03 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
L 501	INDUCTOR,220UH,+-5%,9.4MHZ,SHLD	147835	24759	MR-220	1	
L 502,504	INDUCTOR,15UH,+-5%,41MHZ,SHLD	806513	24759	MR-15	2	
MP 1	SHIELD, WIDEBAND OSCILLATOR, FRONT	775478	89536	775478	1	
MP 2	SHIELD, WIDEBAND OSCILLATOR, REAR	775486	89536	775486	1	
MP 5, 11, 12	CABLE ACCESSORY,CLAMP,ADHESIVE,NYLON	838300	06915	MWSSEB-1-01A	3	
MP 6, 7	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	2	
MP 8, 9	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 10	75 OHM RF CABLE	761304	89536	761304	1	
P 101	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	1	
Q 2, 3	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	698241	04713	2N4401RLRA2	2	
Q 4- 7	ϟ TRANSISTOR,SI,NPN,HI-FREQ,SMALL SIGNL	659417	04713	BFR96	4	
Q 8, 9,101, Q 105,201,205, Q 301,305,401, Q 405,501,505	ϟ TRANSISTOR,SI,N-DMOS FET,TO-72 ϟ ϟ ϟ	394122 394122 394122 394122	18324	SD210EE	12	
Q 102,202,302, Q 402,502	ϟ TRANSISTOR,SI,NPN,SM SIGNAL,HI-FREQ ϟ	272930 272930	04713	2N5943	5	
Q 103,104,203, Q 204,303,304, Q 403,404,503, Q 504	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL ϟ ϟ ϟ	820407 820407 820407 820407	04713	MPS6544RLRA	10	
R 3	RES,CF,300K,+-5%,0.25W	732818	59124	CF1-4VT304J	1	
R 4, 5, 39, R 41	RES,CF,12K,+-5%,0.25W	757799 757799	59124	CF1-4VT123J	4	
R 6, 87	RES,CF,100,+-5%,0.25W	810465	59124	CF1-4VT101J	2	
R 7	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	1	
R 8, 25- 27, R 38, 52, 66, R 67, 79, 80, R 83	RES,CF,1K,+-5%,0.25W	780585 780585 780585 780585	59124	CF1-4VT102J	11	
R 9	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4VT203J	1	
R 11, 12, 15- R 18, 21, 22	RES,CF,51,+-5%,0.25W	572990 572990	59124	CF1-4510JB	8	
R 13, 14, 19, R 20, 23, 24, R 70	RES,CF,270,+-5%,0.25W	573071 573071 573071	59124	CF1-4271JB	7	
R 28- 30, 36, R 81	RES,CF,2K,+-5%,0.25W	810457 810457	59124	CF1-4VT202J	5	
R 31	RES,MF,7.32K,+-1%,0.125W,100PPM	853630	59124	MF50DVT7321B	1	
R 32, 53	RES,MF,1K,+-1%,0.125W,100PPM	816595	59124	MF50DVT1001F	2	
R 33, 42, 43, R 46, 50, 54, R 60, 86,103, R 203,303,403, R 503	RES,MF,49.9,+-1%,0.125W,100PPM	820266 820266 820266 820266 820266	59124	MF50DVT4992F	13	
R 34, 57	RES,MF,30.1,+-1%,0.125W,100PPM	820563	59124	MF50DVT3012F	2	
R 35, 55	RES,MF,3.32K,+-1%,0.125W,100PPM	817601	59124	MF50DVT3321F	2	
R 37	RES,CF,3.9K,+-5%,0.25W	810416	59124	CF1-4VT392J	1	
R 40, 48, 74- R 78,102,110, R 111,113-116, R 202,210,211, R 213-216,302, R 310,311,313, R 402,410,411, R 413,502,510, R 511,513	RES,MF,866,+-1%,0.125W,50PPM	816603 816603 816603 816603 816603 816603 816603 816603 816603	59124	MF50CVT8660F	33	
R 44	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	1	
R 45, 47	RES,MF,200,+-1%,0.125W,100PPM	820282	59124	MF50DVT2000F	2	
R 49	RES,MF,10K,+-1%,0.125W,100PPM	658914	59124	MF50DVT1002F	1	
R 51	RES,MF,4.99K,+-1%,0.125W,100PPM	721548	59124	MF55D4991F	1	
R 56	RES,CC,330,+-5%,0.5W	108936	01121	EB3315	1	

Table 6-7. A6 Wideband Oscillator PCA, Option -03 (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 58,112,212, R 312,412,512	RES,MF,110,+-1%,0.125W,100PPM	820571 820571	59124	MF50DVT1100F	6	
R 59	RES,MF,14.3K,+-1%,0.125W,100PPM	721803	59124	MF50D1432F VT	1	
R 61	RES,MF,2.49K,+-1%,0.125W,100PPM	810523	59124	MF50VTD2491F	1	
R 62, 64, 65, R 69	RES,CC,680,+-5%,0.5W	178392 178392	01121	EB6815	4	
R 63	RES,CF,200,+-5%,0.25W	810390	59124	CF1-4VT201J	1	
R 68	RES,MF,1.62K,+-1%,0.125W,100PPM	772004	59124	MF50DVT1621F	1	
R 71	RES,MF,75,+-1%,0.125W,100PPM	820241	59124	MF50DVT75R0F	1	
R 72, 73	RES,MF,6.65K,+-0.1%,0.125W,100PPM	772558	59124	MF50DVT6651B	2	
R 82	RES,CF,6.2K,+-5%,0.25W	714337	59124	CF1-4VT622J	1	
R 84, 85	RES,CF,240,+-5%,0.25W	830588	59124	CF1-4VT241J	2	
R 101,201,301, R 401,501	RES,CC,220,+-5%,0.5W	186031 186031	01121	EB2215	5	
R 104,204,304, R 404,504	RES,MF,249,+-1%,0.5W,100PPM	241281 241281	91637	CMF65-2490F T-1	5	
R 105,205,305, R 405,505	RES,MF,100,+-1%,0.125W,100PPM	817627 817627	59124	MF50DVT1000F	5	
R 106,107,206, R 207,306,307, R 406,407,506, R 507	RES,CF,130,+-5%,0.25W	817593 817593 817593 817593	59124	CF1-4VT131J	10	
R 108,208,308, R 408,508	RES,MF,523,+-1%,0.125W,100PPM	820274 820274	59124	MF50DVT5230F	5	
R 109,209,309, R 409,509	RES,MF,2.67K,+-1%,0.125W,100PPM	820290 820290	59124	MF50DVT2671F	5	
U 1	ϟ IC,CMOS,4-BIT PHASE LCKD LOOP FRQ SYN	799452	04713	MC145145P-1	1	
U 2	ϟ IC,OP AMP,JFET INPUT,8 PIN DIP	472779	27014	LF356N	1	
U 3	ϟ IC,ECL,VOLTAGE CONTROLLED OSCILLATOR	454975	04713	MC1648P	1	
U 4	ϟ IC,ECL,DUAL D M/S F/F,W/SET&RESET	454959	04713	MC10131P	1	
U 5	ϟ IC,ECL,4-BIT BINARY COUNTER,125MHZ	799460	04713	MC10154P	1	
U 6	ϟ IC,ECL,8-1 LINE MULTIPLEXER (MUX)	799510	04713	MC10164P	1	
U 7, 10, 11	ϟ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	3	
U 8	ϟ IC,CMOS,BCD-DEC & BIN-OCTAL DCDR	473769	27014	CD4028BCN	1	
U 9	ϟ IC,PBLR,MONOLITHIC,DIFF. AMP	783738	34371	CA3102E	1	
U 12, 13	ϟ IC,ARRAY,5 TRANS,NPN,5 ISOLATED TRANS	380188	34371	CA3183E	2	
U 14	ϟ IC,CMOS,QUAD INPUT NOR GATE	811158	04713	MC74HC02N	1	
U 15	ϟ IC,COMPARATOR,HI-SPEED,14 PIN DIP	647115	18324	NE522N	1	
VR 1, 4	ϟ ZENER,UNCOMP,5.1V,5%,20.0MA,0.5W	853700	14552	1N5231B	2	
VR 2,3	ϟ ZENER,UNCOMP,10.0V,5%,20.0MA,0.5W	820480	65940	1N5240BT-88	2	
VR 5	ϟ ZENER,UNCOMP,6.2V,5%,200MA,5W	806802	04713	1N5341B	1	
Z 1	RES,CERM,SIP,10 PIN,9 RES,10K,+-2%	414003	91637	CSC10A-01-103G	1	
Z 2	RES,CERM,SIP,6 PIN,5 RES,10K,+-2%	500876	91637	CSC06A-01 103G	1	
NOTES:	ϟ Static sensitive part.					

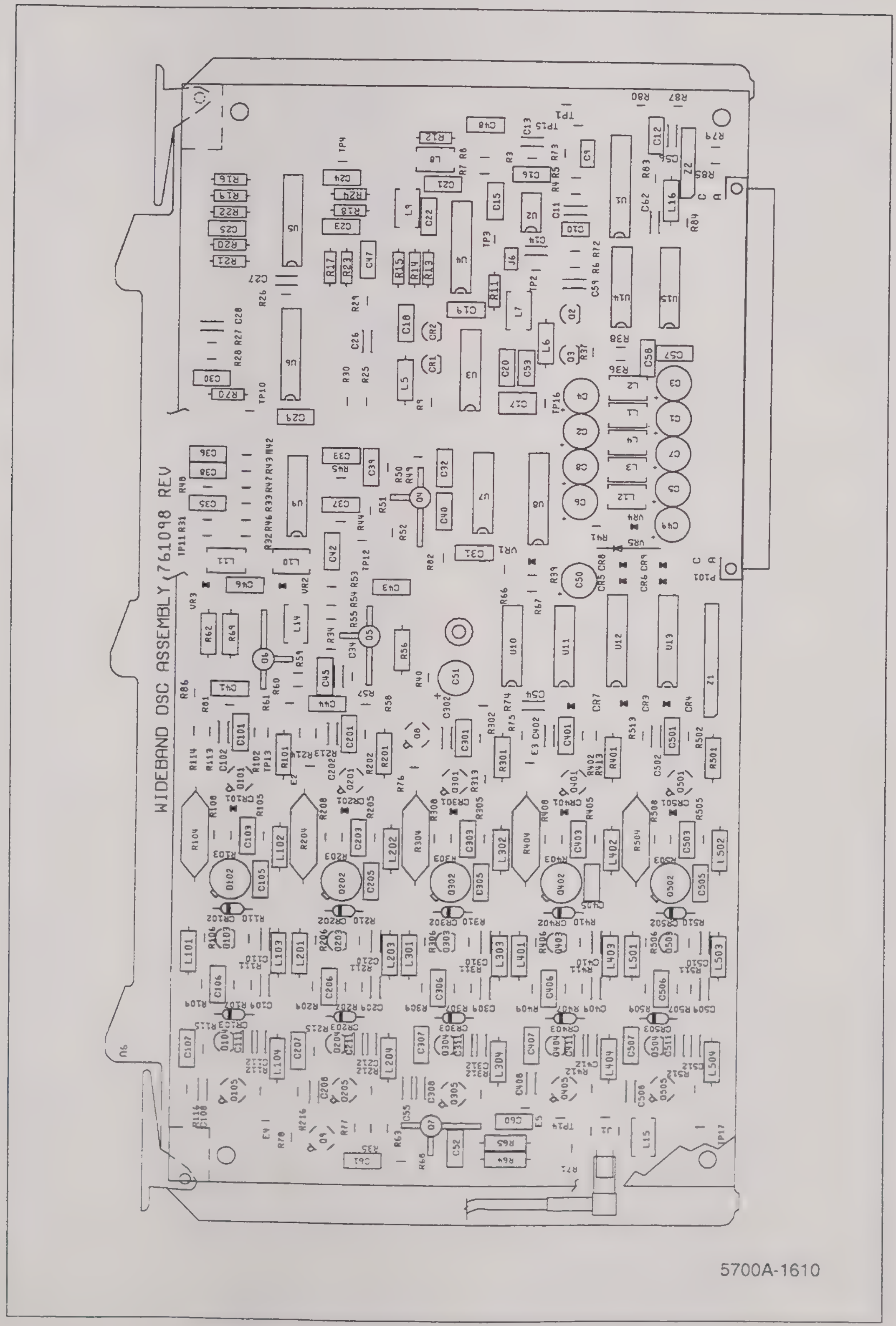

Figure 6-7. A6 Wideband Oscillator PCA, Option -03

Table 6-8. A7 Current/High-Res Oscillator PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,CER,0.22UF,+80-20%,50V,Z5U	649939	04222	SR595E2242AA	1	
C 2, 3, 18- C 20, 29, 32- C 35, 47, 48, C 50, 51, 55, C 56	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913 649913	60935	185-2/0.1K0050RAB	16	
C 4, 5	CAP,CER,100PF,+-2%,100V,C0G	812115	04222	SR291A101GAA	2	
C 6, 7, 21- C 24, 37, 38, C 40, 43, 52, C 53, 60, 61	CAP,TA,4.7UF,+-20%,25V	807644 807644 807644 807644	56289	199D475X0025BA1	14	
C 8	CAP,CER,18PF,+-2%,100V,C0G	830638	04222	SR211A180GAT	1	
C 9	CAP,CER,47PF,+-20%,50V,C0G	706705	04222	SR215A470MAT	1	
C 10	CAP,CER,470PF,+-5%,50V,C0G	830430	04222	SR215A471MAT	1	
C 11	CAP,CER,4700PF,+-20%,100V,C0G	743427	04222	SR301A472MAT	1	
C 12,13,70	CAP,AL,47UF,+-20%,50V,SOLV PROOF	822403	62643	KME50VB47RM6X11RP	3	
C 14	CAP,AL,6.8UF,+-20%,35V,SOLV PROOF	643189	62643	LR35VB6R8M6X0LLV	1	
C 15	CAP,TA,2.2UF,+-20%,16V	706804	56289	199D225X0016AA1	1	
C 16	CAP,CER,1000PF,+-2%,50V,C0G	807966	04222	SR215A102GAT	1	
C 17, 45, 46, C 54	CAP,CER,33PF,+-5%,50V,C0G	714543 714543	04222	SR215A330JAT	4	
C 25, 26, 30, C 36, 41, 42, C 49	CAP,POLYES,0.047UF,+-10%,50V	820548 820548 820548	60935	185/2473K0050RAB	7	
C 27, 28	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	2	
C 31, 67	CAP,POLYES,0.22UF,+-5%,50V	747519	60935	185/.22J0050RCB	2	
C 39	CAP,TA,22UF,+-20%,25V	845149	56289	199D226X0025DG2	1	
C 44	CAP,CER,15PF,+-20%,50V,C0G	697524	04222	SR215A150MAT	1	
C 59	CAP,CER,390PF,+-2%,50V,C0G	820530	04222	SR215A391GAT	1	
C 62	CAP,CER,820PF,+-2%,50V,C0G	631002	04222	SR595A821GAA	1	
C 65, 66	CAP,CER,82PF,+-2%,100V,C0G	512350	04222	SR291A820GATR	2	
C 68	CAP,CER,150PF,+-2%,100V,COG	512988	05397	C315C11J1G5EA	1	
C 69	CAP,CER,47PF,+-2%,100V,C0G	812123	04222	SR291A470GAA	1	
CR 1, 2, 10, CR 11	⚡ DIODE,SI,BV=125.0V,IO=150MA,500 MW	844647 844647	07263	FDH300	4	
CR 3, 4	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	03508	1N4448	2	
CR 9	DIODE,SILICON,VARACTOR,PIV= 28V	598078	04713	MVAM125	1	
CR 12, 13	DIODE,SI,BV=200V,IO=200MA	876867	07263	FDH400	2	
E 1, 2	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	1SOT1	20	
H 1- 4	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
HR 2	⚡ RN/HYBRID CURRENT HYBRID	775387	89536	775387	1	
K 1- 3, 6, K 7, 10- 13, K 16	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307 769307 769307	61529	DS2EML2DC5VH284	10	
K 4, 5, 8, K 9	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078 715078	61529	DS4E-ML2-DC5V-C-H239	4	
K 14, 15, 17	RELAY,ARMATURE,2 FORM C,5V	733063	33297	MR602-5SR	3	
L 1- 3, 5, L 7- 9	CHOKE,6TURN	320911 320911	89536	320911	7	
L 4	INDUCTOR,3.3UH,+-10%,88MHZ,SHLD	174714	24759	MR-3.3	1	
L 10	INDUCTOR,1UH,+-5%,156MHZ,SHLD	806562	24759	MR-1	1	
L 11	INDUCTOR,150UH,+-5%,10.5MHZ,SHLD	174763	24759	MR-150	1	
L 12	INDUCTOR,6800UH,+-5%,1.5MHZ,SHLD	363184	24759	MR-6800J	1	
MP 1- 5	HEAT DIS,PWB MT,.75X.50X.50,TO-220	816587	30161	5968B	5	
MP 6	MOLDED COVER, HYBRID, R-NET	775619	89536	775619	2	
MP 7, 8	SHIELD, HIGH RES., FRONT	775684	89536	775684	2	
MP 9, 10	SHIELD, HIGH RES., REAR	764589	89536	764589	2	
MP 11, 12	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	

Table 6-8. A7 Current/High-Res Oscillator PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
P 211,212	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 1	⚡ TRANSISTOR,SI,BV=40V,40W,TO-220	369660	04713	TIP32T	1	
Q 2, 5, 16, Q 18	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL ⚡	698225 698225	04713	2N3904RLRA2	4	
Q 3, 4, 19	⚡ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	3	
Q 6, 7	⚡ TRANSISTOR,SI,BV=100V,10W	495689	04713	MPS-U56	2	
Q 8, 9	⚡ TRANSISTOR,SI,BV= 80V, 10W,TO-202	535468	04713	MPS-U06	2	
Q 10, 11	⚡ TRANSISTOR,SI,BV=45V,27W,TO-220	325753	09214	D45C5	2	
Q 12, 13	⚡ TRANSISTOR,SI,BV= 45V, 30W,TO-220	325761	09214	D44C5	2	
Q 14, 25	⚡ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	01295	TIP120T	2	
Q 15	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL	698241	04713	2N4401RLRA2	1	
Q 17	⚡ TRANSISTOR,SI,VMOS,PWR,TO-237,VN10KM	640516	17856	V11809	1	
Q 20- 23	⚡ TRANSISTOR,SI,N-DMOS PWR FET,TO-92	782565	59640	VN0104N3	4	
Q 24	⚡ TRANSISTOR, SI, BV=60V, 65W, TO-220	559989	04713	TIP125	1	
R 1, 38- 40, R 44, 54, 55, R 61, 62, 65, R 78, 91	RES,CF,1K,+-5%,0.25W	780585 780585 780585 780585	59124	CF1-4VT102J	12	
R 3, 36	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	2	
R 4, 9, 94	RES,MF,1K,+-1%,0.125W,100PPM	816595	59124	MF50DVT1001F	3	
R 5, 8	RES,CF,62K,+-5%,0.25W	713941	59124	CF1-4VT623J	2	
R 6, 7	RES,MF,8.87K,+-1%,0.125W,100PPM	658922	59124	MF50DVT8871F	2	
R 10, 12, 29, R 32	RES,MF,8.25K,+-1%,0.125W,100PPM	820357 820357	59124	MF50DVT8251F	4	
R 11, 13, 81, R 82	RES,MF,1K,+-1%,0.125W,100PPM	820308 820308	59124	MF50DVT1001F	4	
R 14	RES,WW,1.2,+-5%,2W	248658	23237	SPH21R2J	1	
R 16	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4VT203J	1	
R 17, 37, 50- R 52	RES,CF,16K,+-5%,0.25W	714303 714303	59124	CF1-4VT163J	5	
R 18, 89, 95	RES,CF,1.5K,+-5%,0.25W	810432	59124	CF1-4VT152J	3	
R 19	RES,MF,150,+-1%,0.125W,100PPM	822171	59124	MF50DVT1500F	1	
R 20- 23	RES,MF,162,+-1%,0.125W,100PPM	820340	59124	MF50DVT1620F	4	
R 24- 27	RES,MF,13,+-1%,0.5W,100PPM	820233	23783	820223	4	
R 28, 30, 33	RES,MF,10K,+-1%,0.125W,100PPM	658914	59124	MF50DVT1002F	3	
R 31	RES,MF,4.12K,+-1%,0.125W,100PPM	820381	59124	MF50DVT4121F	1	
R 34	RES,MF,1.91K,+-1%,0.125W,100PPM	820365	59124	MF50DVT1911F	1	
R 35, 66, 72, R 73, 90	RES,CF,100,+-5%,0.25W	810465 810465	59124	CF1-4VT101J	5	
R 42	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	1	
R 43, 60, 67, R 68	RES,CF,10K,+-5%,0.25W	697102 697102	59124	CF1-4VT103J	4	
R 45, 46	RES,CF,33K,+-5%,0.25W	733667	59124	CF1-4VT333J	2	
R 47, 48	RES,CF,130K,+-5%,0.25W	747436	59124	CF1-4VT134J	2	
R 49	RES,CF,2.4M,+-5%,0.25W	772566	59124	CF1-4VT245J	1	
R 53	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	1	
R 56, 57	RES,CC,470,+-10%,1W	109710	01121	GB4711	2	
R 58	RES,CF,620,+-5%,0.25W	810408	59124	CF1-4VT621J	1	
R 59, 63, 93	RES,CF,3K,+-5%,0.25W	810366	59124	CF1-4VT302J	3	
R 64	RES,MF,10,+-1%,0.125W,100PPM	820399	59124	MF50DVT10R0F	1	
R 70	RES,MF,100,+-1%,0.125W,100PPM	817627	59124	MF50D100F	1	
R 71	RES,MF,7.32K,+-1%,0.125W,100PPM	853630	59124	MF50D8321F	1	
R 74, 75	RES,CF,47,+-5%,0.25W	822189	59124	CF1-4VT470J	2	
R 76, 77, 92	RES,CF,240,+-5%,0.25W	830588	59124	CF1/4VT241J	3	
R 79, 80	RES,MF,787,+-1%,0.125W,100PPM	853627	59124	MF50DVT7870F	2	
R 83, 84	RES,CF,330,+-5%,0.25W	830596	59124	CF1-4VT331J	2	

Table 6-8. A7 Current/High-Res Oscillator PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 85, 86	RES,WW,27,+-5%,2W	844563	05347	CS3N101270J	2	
R 87, 88	RES,CF,51K+-5%,0.25W	747550	59124	CF1-4VT513J	2	
R 96, 97	RES,MF,200,+-1%,0.125W,100PPM	820282	24759	MF50D2000F	2	
RT 1, 2	THERMISTOR,DISC,4.85,25C	838102	1EJ84	RXE017	2	
U 2, 3	ϟ IC,OP AMP,PRECISION,LOW NOISE	782920	64155	LT1007CN8	2	
U 4, 22	ϟ IC,OP AMP,JFET INPUT,22V SUPPLY,DIP	832584	04713	LF356BN	2	
U 5, 18	ϟ IC,CMOS,QUAD BILATERAL SWITCH	910708	17856	DG444DJ	2	
U 6, 20	ϟ IC,OP AMP,DUAL,PRECISION,8-PIN DIP	783696	64155	LT1013CN8	2	
U 7	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 8- 10	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	3	
U 11	ϟ IC,BIMOS,4 CHNL HI-VOLT DRVR W/LATCH	820514	56289	UCN-5800A	1	
U 12	ϟ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
U 13	ϟ IC,COMPARATOR,HI-SPEED,14 PIN DIP	647115	18324	NE522N	1	
U 14	ϟ IC,CMOS,DUAL D F/F,+EDG TRG,W/CLR	741702	04713	MC74HC74N	1	
U 15	ϟ IC,CMOS,QUAD INPUT NOR GATE	811158	04713	MC74HC02N	1	
U 16	ϟ IC,CMOS,4-BIT PHASE LCKD LOOP FRQ SYN	799452	04713	MC145145P1	1	
U 17	ϟ IC,CMOS,4-BIT PHASE LCKD LOOP FRQ SYN	820506	04713	MC145146P1	1	
U 19	ϟ IC,ECL,VOLTAGE CONTROLLED OSCILLATOR	454975	04713	MC1648P	1	
U 21	ϟ IC,LSTTL,DUAL D F/F,+EDG TRG,W/CLR	393124	04713	SN74LS74AN	1	
VR 3	ϟ ZENER,UNCOMP,5.6V,5%,20MA,0.5W	820464	04713	1N5232BRR1	1	
XU 2, 3	SOCKET,IC,8 PIN	478016	00779	2-640463-1	2	
Z 1	ϟ RES,NET,THN F, 40.K(8)+-500/2.0PPM	760835	89536	760835	1	
Z 2	RES,CERM,SIP,6 PIN,5 RES,10K,+-2%	500876	91637	CSC06A-01-103G	1	
Z 3	RES,CERM,NET,8 PINS,4 RES,10K	855150	91637	CSC08B-03-103G	1	
NOTES:	ϟ Static sensitive part.					

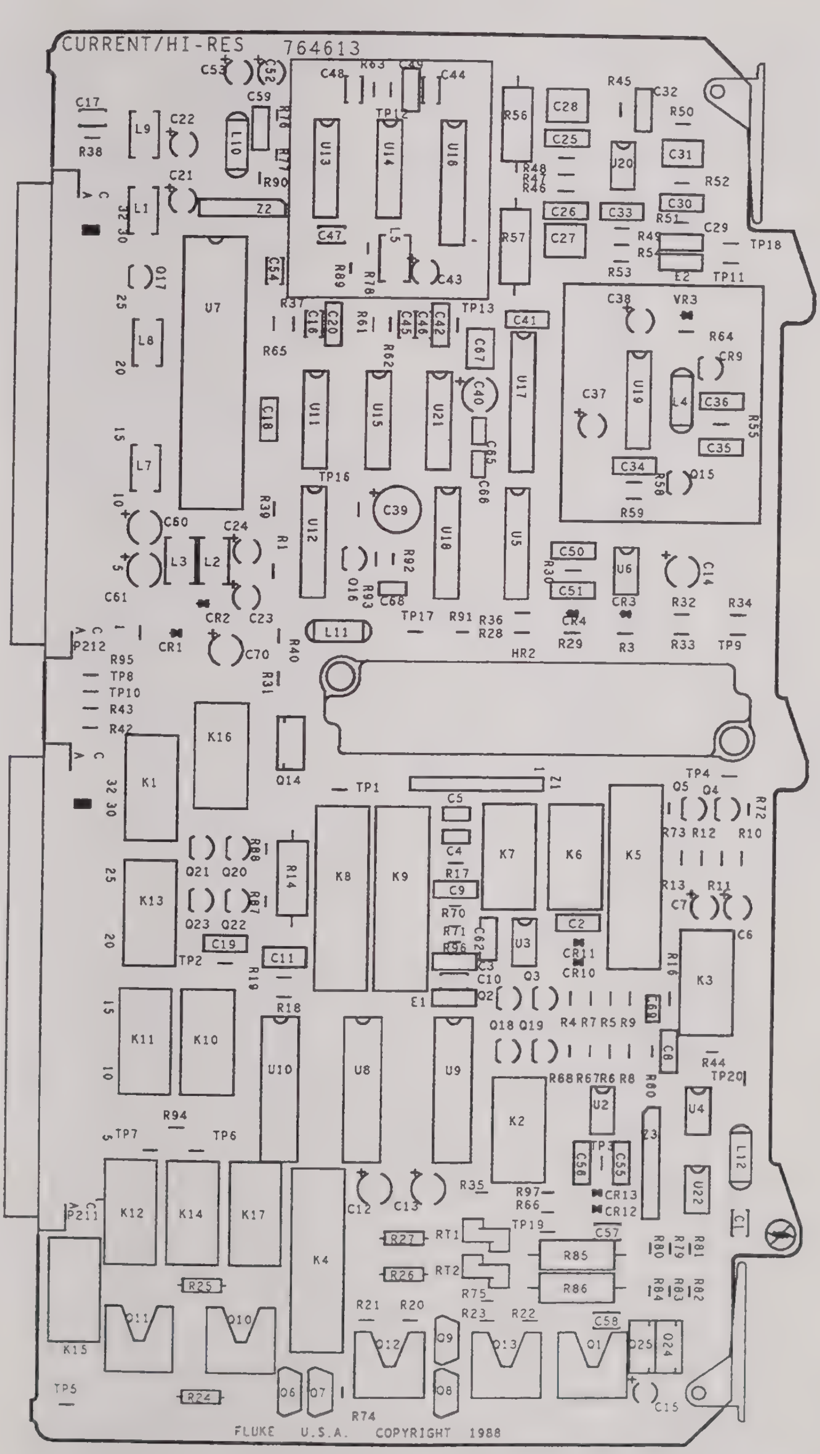

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Figure 6-8. A7 Current/High-Res Oscillator PCA

Table 6-9. A8 Switch Matrix PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 3, 18	CAP,CER,470PF,+-10%,50V,C0G	733071	04222	SR215A471KAT	3	
C 2, 5	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 4	CAP,CER,0.01UF,+80-20%,50V,Z5V	697284	51406	DD106L10Z5U103M50V	1	
C 6- 9, 12, C 13, 15, 16, C 21, 25- 27	CAP,POLYES,0.22UF,+-5%,50V	747519 747519 747519	60935	185.22/J0050RCB	12	
C 10, 29	CAP,CER,100PF,+-20%,50V,C0G	721605	72982	RPE113Z5U101M50V	2	
C 14	CAP,CER,15PF,+-2%,100V,C0G	832287	04222	SR211A156GAT	1	
C 17	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RAB	1	
C 19	CAP,POLYES,0.1UF,+-10%,50V	649913	60935	185-2/0.1K0050RAB	1	
C 20	CAP,CER,1000PF,+-20%,50V,X7R	697458	89536	697458	1	
C 22	CAP,TA,15UF,+-20%,20V	807610	56289	199D156X0020DA1	1	
C 23	CAP,CER,22PF,+-2%,50V,C0G	714832	04222	SR215A220GAT	1	
C 30	CAP,CER,330PF,+-5%,50V,C0G	697441	04222	SR215A331JAT	1	
CR 1, 3, 4, CR 7- 9, 12, CR 13	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED ⚡ ⚡	659516 659516 659516	03508	1N4448	8	
CR 2, 10	DIODE,SI,100 PIV,1.0 AMP	698555	04713	1N4002RL	2	
CR 5, 6	⚡ DIODE,SI,BV=30V,IO=150MA,250MW	853523	07263	FJT1100	2	
CR 14, 15	DIODE,SI,100 PIV,1.0 AMP	820449	65940	1N4002A-T20(A)	2	
H 5- 8	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
HY 1	HYBRID ASSEMBLY,TESTED	813436	89536	813436	1	
K 1, 3- 6, K 13, 15- 20, K 22, 24, 25	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078 715078 715078	61529	DS4EML2DC5VCH239	15	
K 2, 7- 12, K 14, 21, 23, K 26- 33	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307 769307 769307	61529	DS2EML2DC5VCH284	18	
L 1- 4	CHOKE,6TURN	320911	89536	320911	4	
MP 2	MOLDED COVER, HYBRID, R-NET	775619	89536	775619	1	
MP 9, 10	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
P 201,202	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 1,	⚡ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP120T	1	
Q 2	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	04713	2N3904RLRA2	1	
Q 4	⚡ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
Q 6, 7, 11	⚡ TRANSISTOR,SI,N-DMOS PWR FET,TO-92	782565	59640	VN0104N3	3	
Q 9, 10	⚡ TRANSISTOR,SI,N-JFET,TO92	845073	17856	J2929	2	
Q 12, 13	⚡ TRANSISTOR,SI,N-JFET,HI-VOLTAGE,TO-92	832147	17856	J2907-TR3	2	
R 1	RES,MF,15.4K,+-1%,0.125W,100PPM	772038	59124	MF50DVT1542J	1	
R 2	RES,MF,1.21K,+-1%,0.125W,100PPM	810507	59124	MF50DVT1211F	1	
R 3, 4, 6	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4VT103J	3	
R 5, 7, 10, R 19, 34	RES,MF,1K,+-1%,0.125W,100PPM	816595 816595	59124	MF50DVT1001F	5	
R 8	RES,MF,12.7K,+-1%,0.125W,25PPM	817510	91637	CMF501272F T-9	1	
R 9, 46, 47	RES,MF,10K,+-0.1%,0.125W,50PPM	733972	59124	MF50CVT1002B	3	
R 11, 20, 35	RES,CF,560,+-5%,0.25W	810440	59124	CF1-4VT561J	3	
R 12	RES,CF,1.5,+-5%,0.25W	732800	59124	CF1-4VT1R5J	1	
R 13	RES,CF,330,+-5%,0.25W	830596	59124	CF1-4VT331J	1	
R 14,	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	1	
R 15- 17, 21	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	4	
R 18, 33, 44	RES,MF,20K,+-0.1%,0.25W,25PPM	810564	91637	CMF552002B T-9	3	
R 22	RES,CF,1K,+-5%,0.25W	780585	59124	CF1/4102J	1	
R 23, 39, R 40	RES,CF,100,+-5%,0.25W	810465 810465	59124	CF1-4VT101J	3	
R 24	1/4 WATT HERM. W.W. RESISTOR	864207	89536	864207	1	
R 25	RES,CF,6.2K,+-5%,0.25W	714337	59124	CF1-4VT622J	1	

Table 6-9. A8 Switch Matrix PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 26	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	1	
R 27, 28	RES,CF,620,+-5%,0.25W	810408	59124	CF1-4VT621J	2	
R 29, 30	RES,MF,14.3,+-1%,0.125W,100PPM	831396	59124	MF50DVT14R3F	2	
R 32	RES,MF,10,+-1%,0.125W,100PPM	820399	59124	MF50DVT10R0F	1	
R 38	RES,CC,47,+-5%,0.125W	512061	01121	BB4705	1	
R 41, 42	RES,CF,20,+-5%,0.25W	810382	59124	CF1-4VT200J	2	
R 43	RES,MF,150,+-1%,0.125W,100PPM	822171	59124	MF50DVT1500F	1	
T 1	MV COMMON MODE CHOKE	802751	89536	802751	1	
TP 1- 10	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	1SOT1	10	
U 1	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 2	ϟ IC,CMOS,BCD-DEC & BINRY-OCTAL DECODER	650689	04713	MC14028BCPD	1	
U 3	ϟ IC,BPLR,FAHRENHEIT TEMPERTURE SENSOR	845156	27014	LM34CZ	1	
U 4	ϟ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
U 5- 13	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	9	
U 15	ϟ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 17	ϟ IC,OP AMP,GEN PURPOSE,COMPEMSATED	402750	27014	LM741CN	1	
U 19	ϟ IC,ARRAY,5 TRANS,5 ISO: 2-PNP,3-NPN	418954	02735	CA3096E	1	
U 20	ϟ IC,OP AMP,PRECISION,LOW NOISE	782920	64155	LT1007CN8	1	
U 21	ϟ IC,OP AMP,LO-OFFSET VOLTAGE,LO-NOISE	605980	06665	OP-07DP	1	
VR 1, 2	ϟ ZENER,UNCOMP,6.8V,5%,20.0MA,0.4W	820431	04713	1N754ARR1	2	
Z 1	RES,NET,THN F	759647	89536	759647	1	
Z 2	ϟ RNET,8840A OUTPUT DIVIDER	655811	89536	655811	1	
Z 3, 4	RES,CERM,SIP,6 PIN,5 RES,330,+-2%	408302	91637	CSC06A-01-3R30G	2	
Z 5	RES,CERM,SIP,8 PIN,4 RES,10K,+-2%	513309	91637	CSC08A-03-103G	1	
Z 6	RES,CERM,SIP,6 PIN,5 RES,1K,+-2%	408310	91637	CSC06A-01-102G	1	
NOTES:	ϟ Static sensitive part.					

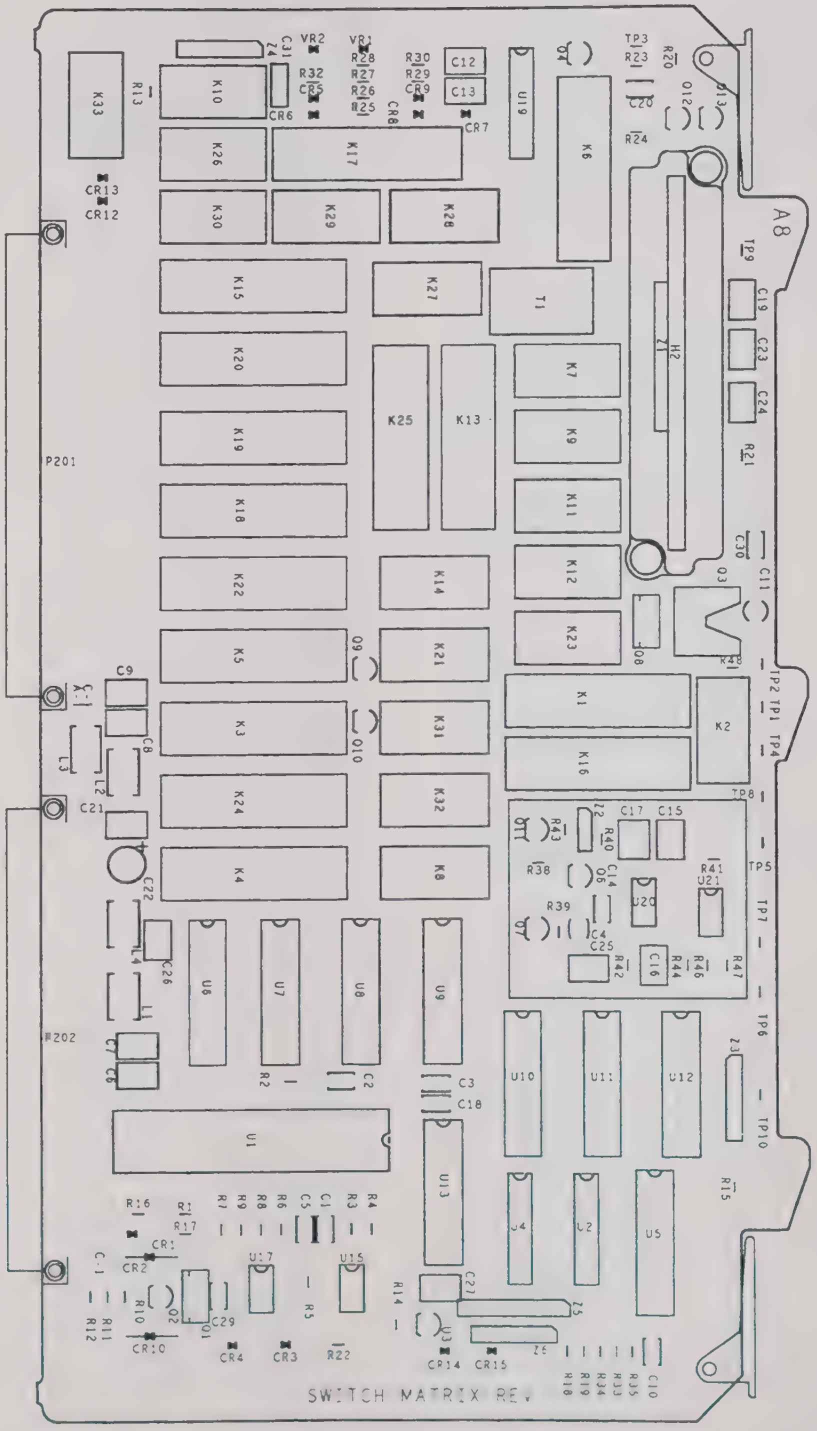

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Figure 6-9. A8 Switch Matrix PCA

Table 6-10. A9 Ohms Cal PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 28, 29, C 55	CAP,POLYES,0.1UF,+-10%,50V	649913 649913	60935	185-2/0.1K0050RAB	4	
C 2, 3, 32, C 35	CAP,CER,1000PF,+-20%,100V,X7R	816181 816181	04222	SR171C102MAA	4	
C 4, 5, 8, C 10, 14, 15, C 31, 37- 43, C 45	CAP,POLYES,0.22UF,+-5%,50V	747519 747519 747519 747519	60935	185.22/J/0050/R/C/B	15	
C 7, 9, 22, C 23	CAP,TA,2.2UF,+-10%,35V	697433 697433	31433	T356E225K035AS	4	
C 12, 13	CAP,CER,220PF,+-20%,50V,C0G	740654	04222	SR215A221MAT	2	
C 16, 17	CAP,CER,22PF,+-5%,50V,C0G	714550	04222	SR215A220JAT	2	
C 18, 33	CAP,TA,4.7UF,+-20%,25V	807644	56289	199D475X0025BA1	2	
C 19, 24, 25	CAP,TA,10UF,+-20%,35V	816512	56289	199D106X9035DA1	3	
C 20, 52	CAP,CER,0.22UF,+80-20%,50V,Z5U	649939	04222	SR215E224MAA	2	
C 21	CAP,CER,2700PF,+-5%,50V,C0G	832303	04222	SR215A272JAT	1	
C 26, 27	CAP,CER,1800PF,+-5%,50V,C0G	832717	04222	SR215A182JAT	2	
C 30	CAP,POLYPR,0.1UF,+-10%,160V	446781	60935	171/.1/K/160/D	1	
C 34, 51	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 36	CAP,TA,47UF,+-20%,10V	733246	56289	199D476X0010DA1	1	
C 48	CAP,POLYPR,0.47UF,+-10%,160V	446807	60935	171/.47K160H	1	
C 53, 54	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	2	
CR 1- 10	ϟ DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	03508	1N4448	10	
H 1- 4	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 5	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	1	
K 1- 5, 10, K 11, 13, 15- K 18, 20, 22- K 27, 31	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307 769307 769307 769307	61529	DS2EML2DC5VH284	20	
K 6- 9, 12, K 14, 19, 21, K 28- 30	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078 715078 715078	61529	DS4E-ML2-DC5V-C-H239	11	
L 2- 8	CHOKE,6TURN	320911	89536	320911	7	
M 4	SHIELD, OHMS CAL	775312	89536	775312	1	
MP 1, 2	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 3	SLEEV,PVC,0.500ID,CLEAR	113761	88690	ASTRA703/105	2	
MP 4	SHIELD, HIGH VOLTAGE CONTROL	761197	89536	761197	1	
MP 6- 17	SPACER,RND,SOLUBLE,.156OD,.060THK	296319	32559	TO-8-06	15	
P 311,312	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 1	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP120T	1	
Q 2- 4	ϟ TRANSISTOR,SI,VMOS,PWR,TO-237	640516	17856	V11809	3	
Q 5	ϟ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
Q 6	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	04713	2N3904RLRA2	1	
R 1-3, 80	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4VT103J	4	
R 4, 8, 13, R 32, 35, 39, R 45	RES,CF,1K,+-5%,0.25W	780585 780585 780585	59124	CF1-4VT102J	7	
R 9, 10, 43, R 44	RES,CF,47,+-5%,0.25W	822189 822189	59124	CF1-4VT470J	4	
R 11	RES,CC,330,+-5%,1W	163394	01121	GB3311	1	
R 12, 23	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	2	
R 26, 46	RES,CF,100,+-5%,0.25W	810465	59124	CF1-4VT101J	2	
R 14, 15	RES,CF,24,+-5%,0.25W	817528	59124	CF1-4VT240J	2	
R 16, 17	RES,MF,10K,+-0.1%,0.125W,100PPM	658955	59124	MF50DVT1002B	2	
R 18	RES,MF,76K,+-0.1%,0.125W,50PPM	851332	59124	MF50CVT763B	1	
R 24, 31	RES,CF,22K,+-5%,0.25W	747535	59124	CF55VT223J	2	
R 25	RES,CC,150,+-5%,1W	178566	01121	GB1515	1	
R 27	RES,MF,10K,+-1%,0.125W,100PPM	658914	59124	MF50DVT1002F	1	

Table 6-10. A9 Ohms Cal PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 29, 30	RES,CF,200,+-5%,0.25W	810390	59124	CF1-4VT201J	2	
R 32, 35, 39, R 45	RES,CF,1K,+-5%,0.25W	780585 780585	59124	CF1-4VT102J	4	
R 33	RES,CF,16K,+-5%,0.25W	714303	59124	CF1-4VT163J	1	
R 41	RES. SET,1.0 OHM 0.04% 3PPM TC	824193	89536	824193	1	
R 42	RES. SET,1.9 OHM 0.04% 3PPM TC	824201	89536	824201	1	
T 1	TRANSFORMER, OHMS 2W COMP	802652	89536	802652	1	
TP 1, 2, 5- TP 20	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	91984	150T1	18	
U 1- 3	ϟ IC,OP AMP,LO-OFFSET VOLTAGE,LO-NOISE	605980	06665	OP-07DP	3	
U 4	ϟ IC,OP AMP,PRECISION,LOW NOISE	782920	64155	LT1007CN8	1	
U 5	ϟ IC,OP AMP,GEN PURPOSE,COMPEMSATED	402750	27014	LM741CN	1	
U 6	ϟ IC,BIPOLAR,REG PULSE WIDTH MODULATOR	811935	64155	LT3526N	1	
U 7	ϟ IC,OP AMP,CHOPPER STABLIZED,LOW NOISE	810952	64155	LT1052CN/FLOW 52	1	
U 8, 9	ϟ IC,OP AMP,LO-NOISE,8 PIN DIP	495051	18324	N35534N	2	
U 10	ϟ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	854059	06665	OP215EZ	1	
U 11	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 12	ϟ IC,CMOS,BCD-DEC & BINRY-OCTAL DECODER	650689	04713	MC14028BCPD	1	
U 13	ϟ IC,CMOS,3-8 LINE DCDR W/ENABLE	773036	04713	MC74HC138N	1	
U 14- 20	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	7	
U 21	ϟ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
U 22	ϟ IC,CMOS,HEX INVERTER,UNBUFFERED	741199	04713	MC74HCU04N	1	
VR 1, 2	ϟ ZENER,UNCOMP,8.2V,5%,20MA,0.4W	810309	04713	1N756ARR1	2	
VR 3	ϟ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W	820423	04713	1N746ARR1	1	
Z 1	ϟ RES NET THK FILM TESTED	813659	89536	813659	1	
Z 2	ϟ RES NET THK FILM TESTED	809368	89536	809368	1	
Z 3	RES,CERM,SIP,10 PIN,5 RES,10K,+-2%	529990	71450	750	1	
Z 4	RES,CERM,SIP,6 PIN,5 RES,1K,+-2%	408310	91637	CSC10A-03-101G	1	
Z 5	OHMS CAL REF DIVIDER	915889	89536	915889	1	
NOTES:	ϟ Static sensitive part.					

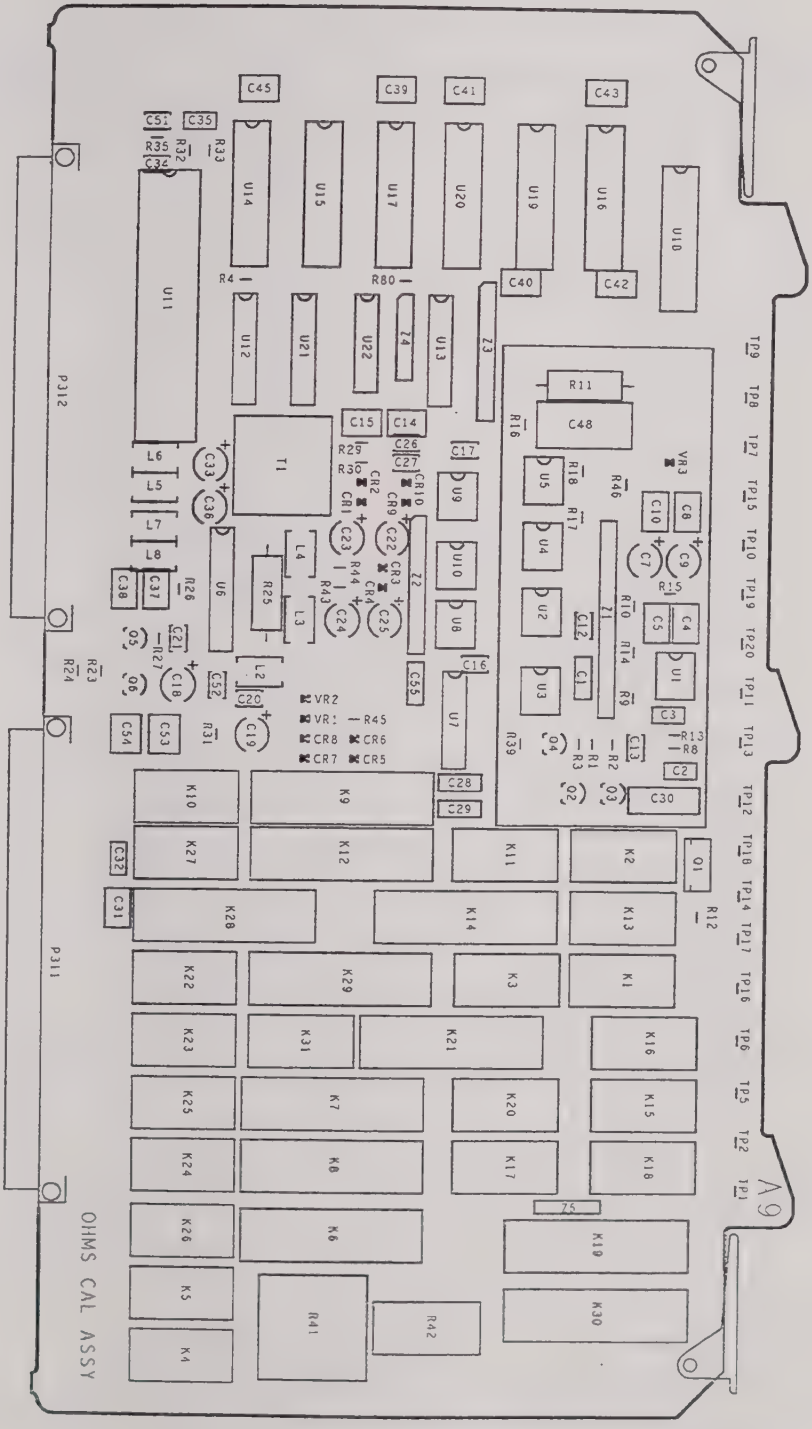

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Figure 6-10. A9 Ohms Cal PCA

Table 6-11. A10 Ohms Main PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 2, 7, C 10- 13, 16	CAP,POLYES,0.22UF,+-5%,50V	747519 747519	68919	MKS2224J50	8	
C 3, 4	CAP,TA,10UF,+-20%,35V	816512	56289	199D106X0035DG2	2	
C 6	CAP,TA,4.7UF,+-20%,25V	807644	56289	199D475X0025BE2	1	
H 3- 6	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 7, 8	SCREW,PH,P,LOCK,STL,6-32,.250	152140	74594	152140	2	
K 1- 4, 7, K 9, 10, 13- K 17, 28- 30, K 33- 37	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307 769307 769307 769307	61529	DS2EML2DC5VCH284	20	
K 5	RELAY,REED,1 FORM A,5VDC	806950	71707	7003-5065	1	
K 6, 8, 11, K 12	RELAY,REED,1 FORM A,4.5VDC	544031 544031	71707	1240-0129	4	
K 18- 27, 31, K 32, 39	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078 715078	61529	DS4EML2DC5VCH239	13	
K 38	RELAY,ARMATURE,2 FORM C,5V	733063	61529	DS2E-S-DC5V	1	
L 4, 5	CHOKE,6TURN	320911	89536	320911	2	
MP 1, 2	SPACER,SWAGE,.250 RND,BR,6-32,.875	266486	55566	3057B632B14	2	
MP 3, 4	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 6	FOOT,RUBBER,ADHES,BLK,.50 SQ,.12 THK	543488	28213	SJ-5008	1	
MP 7	ϟ OHMS, MAIN, HEAT SHIELD	872325	89536	872325	1	
P 301,302	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
R 1	ϟ RES,CERM,90M,+-.025%,0.75W,10 PPM	783654	19647	TF656R	1	
R 2, 3	RES,CF,270,+-5%,0.25W	810424	59124	CF1/4 271J	2	
R 5	RES,CF,100,+-5%,0.25W	810465	59124	CF1/4 101J	1	
R 6	RES,MF,110K,+-1%,0.125W,100PPM	719526	91637	CMF-55 1103F T-1	1	
TP 1- 5	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	5	
U 1	ϟ IC,OP AMP,JFET INPUT,LOW NOISE,TO-99	807933	13919	OPA111AM	1	
U 2, 3, 5- U 8, 11- 13	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH ϟ	782912 782912	56289	UCN-5801A	9	
U 9	ϟ IC,CMOS,BCD-DEC & BINRY-OCTAL DECODER	650689	04713	MC14028BCPD	1	
U 10	ϟ IC,CMOS,3-8 LINE DCDR W/ENABLE	773036	01295	SN74HC138N	1	
VR 1	ϟ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W	820423	04713	1N746	1	
Z 1	ϟ RES NET THN F TESTED	798330	89536	798330	1	
Z 2	ϟ RES,NET,THN F, 10.MEG,(7)+-250/20PPM	759753	89536	759753	1	
Z 3	ϟ RES,NET,THN F,	759803	89536	759803	1	
NOTES:	ϟ Static sensitive part.					

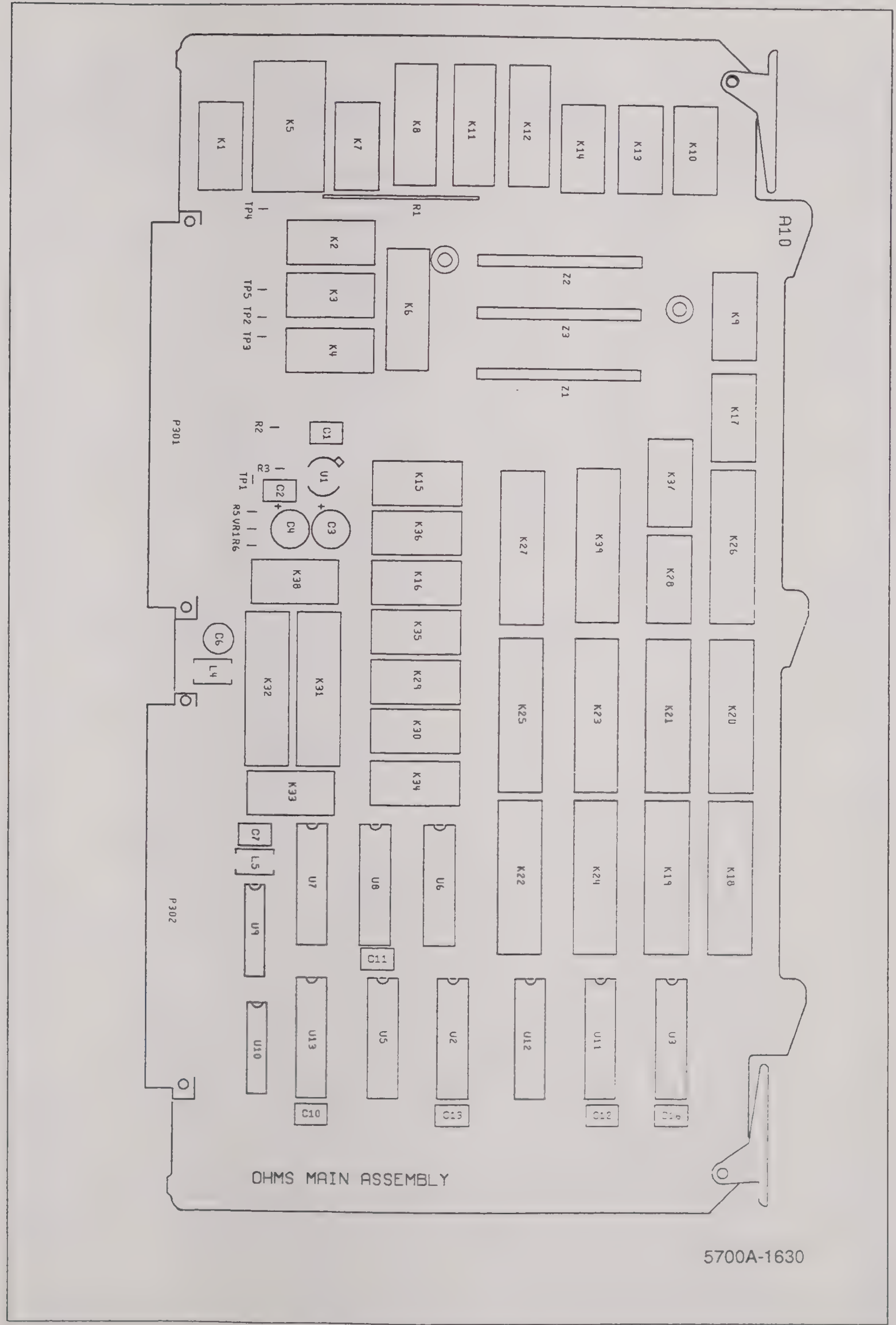


Figure 6-11. A10 Ohms Main PCA

Table 6-12. A11 DAC PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	DAC FILTER SIP PCA	761395	89536	761395	1	
A 2	⚡ DAC BUFFERED REFERENCE SIP PCA	764639	89536	764639	1	
C 1, 2, 4- C 8, 10, 11, C 13- 18, 21, C 23- 26, 30, C 31, 41, 42, C 46- 49, 53- C 56, 58, 62, C 64, 65, 76, C 77, 81, 86- C 88, 91, 92, C 96- 98,100, C 104-109	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597 740597 740597 740597 740597 740597 740597 740597 740597 740597 740597 740597	51406	GRM42-Y5U221Z050PB	54	
C 3	CAP,CER,3300PF,+-10%,25V,X7R,0805	602870	04222	08051C332KAT050R	1	
C 9, 12	CAP,AL,10UF,+-20%,63V,SOLV PROOF	816843	62643	KME63VB10RM5X11RP	2	
C 19, 20	CAP,TA,2.2UF,+-10%,35V	697433	56289	199D225X9035BG2	2	
C 27	CAP,CER,15PF,+-20%,50V,C0G	697524	04222	SR595A150MAATR1A	1	
C 29	CAP,CER,220PF,+-2%,100V,C0G	816728	04222	SR591A221GAATR1A	1	
C 32	CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	04222	12063C104KAT060B	1	
C 40, 80	CAP,CER,47PF,+-10%,50V,C0G,1206	747352	04222	12065A470KAT060B	2	
C 43	CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	04222	12065C103KAT060R	1	
C 44, 60, 63, C 94,102	CAP,CER,1000PF,+-10%,50V,C0G,1206	747378 747378	04222	12065A102KAT060B	5	
C 45, 89, 95	CAP,POLYPR,0.1UF,+-10%,160V	446781	60935	171/0.1/K/160/D	3	
C 52,101,103	CAP,CER,33PF,+-10%,50V,C0G,1206	769240	04222	12065A330KAT050B	3	
C 57, 85	CAP,CER,22PF,+-5%,50V,C0G	714550	04222	SR595A220JAATR1A	2	
C 59, 67	CAP,CER,100PF,+-10%,50V,C0G,1206	740571	04222	12065A101KAT060B	2	
C 78	CAP,POLYES,0.47UF,+-10%,50V	697409	60935	185-2/0.47/K/0050/R/A/B	1	
C 79	CAP,CER,10PF,+-10%,100V,C0G,1206	806943	04222	12061A100KAT050B	1	
C 84	CAP,POLYPR,0.022UF,+-10%,160V	494948	68919	MKP4-223-K-160V	1	
C 90	CAP,POLYPR,0.033UF,+-10%,63V	721050	68919	MKP20-333-K-63V	1	
C 93	CAP,CER,330PF,+-5%,50V,C0G	697441	04222	SR595A331JAATR1A	1	
C 110,111	CAP,POLYES,0.22UF,+-10%,50V	706028	60935	185-2/0.22/K/0050/R/C/B	2	
CR 1, 3- 6, CR 8, 12, 13	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED ⚡	659516 659516	03508	1N4448	8	
CR 2	⚡ DIODE,SI,N-JFET,CURRENT REG,IF=0.24MA	741512	17856	J9060TR	1	
CR 7	⚡ DIODE,SI,N-JFET,CURRENT REG,IF=1.0 MA	832105	17856	J2900	1	
CR 9, 10	⚡ DIODE,SI,BV=75V,IO=250MA,SOT23	830489	8A233	BAS16	2	
CR 14	⚡ DIODE,SI,N-JFET,CURRENT REG,IF=5.3MA	852116	17856	J9010	1	
H 1	SCREW,PH,P,STL,LOCK,6-32,.500	152173	73734	19046	1	
H 2	FORM,C-MOS-HANDLING	464016	89536	464016	1	
H 9- 12	RIVET,S-TUB,OVAL,STL,.087,.343	838458	40551	502	4	
H 21	SCREW,PH,P,STL,LOCK,4-40,.187	129882	89536	129882	1	
H 26	NUT,HEX,STL,4-40	184044	73734	8002A-NP	1	
H 28	TERM,RING 5/64 & .144,SOLDR	101055	79963	9.074.020,BR,ELEC-TIN	1	
H 32	SHIELD, DAC, FRONT	786483	89536	786483	1	
HR 5	⚡ REFERENCE HYBRID ASSY	761338	89536	761338	1	
HR 6	⚡ DC AMP HYBRID ASSY	761411	89536	761411	1	
K 1, 2, 4	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	3	
K 3, 5- 8	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VCH284	5	
L 1- 7, 10	CHOKE,6TURN	320911	89536	320911	8	
M 2	SHIELD, DAC-ADC AMP	786509	89536	786509	1	
M 3	SHIELD, DAC, REAR	786491	89536	786491	1	
MP 1	MOLDED COVER, HYBRID, R-NET	775619	89536	775619	1	
MP 2, 3	SPACER,SWAGED,.250 RND,BR,6-32,.875	266486	06540	9543B-B-0632	2	

Table 6-12. A11 DAC PCA (cont)

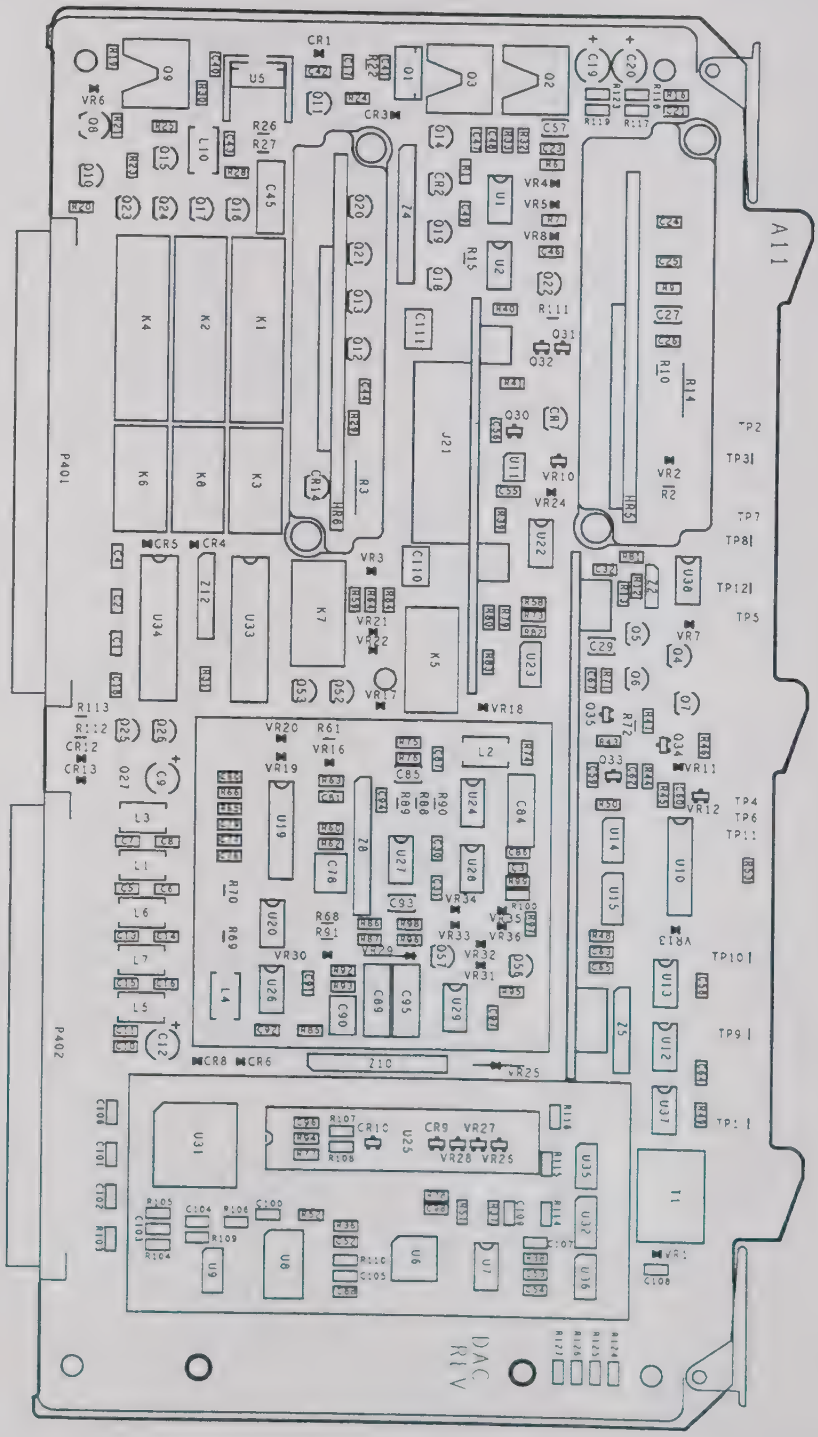
REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
MP 4	BAG,STATIC SHIELDING,10"X14"	680967	89536	680967	1	
MP 5, 6	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 7- 9	HEAT DIS,PWB MT,.75X.50X.50,TO-220	816587	30161	5968B	3	
MP 10	HEAT DIS,VERT,.75X.52X.50,TO-220	811760	30161	5972B	1	
MP 11	SHIELD, DAC, FRONT, SMALL	786434	89536	786434	1	
MP 31	MOLDED COVER, REFERENCE HYBRID	797746	89536	797746	1	
P 401,402	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 1, 9	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP120T	2	
Q 2, 3	ϟ TRANSISTOR,SI,BV=40V,40W,TO-220	369660	04713	TIP32T	2	
Q 4- 7, 11, Q 22, 25, 26	ϟ TRANSISTOR,SI,N-DMOS PWR FET,TO-92 ϟ	782565 782565	59640	VN0104N3	8	
Q 8	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	288761	56289	288761	1	
Q 10, 19, 56	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,TO-92	698225	04713	2N3904RLRA2	3	
Q 12, 13, 16, Q 17, 23, 24	ϟ TRANSISTOR,SI,N-JFET,HI-VOLTAGE,TO-92 ϟ	832147 832147	17856	J2907-TR3	6	
Q 14, 15, 18, Q 20, 21, 52, Q 53	ϟ TRANSISTOR,SI,N-CHAN,TO-92,SWITCH ϟ ϟ	832139 832139 832139	17856	J2903	7	
Q 30, 32	ϟ TRANSISTOR,SI,N-JFET,SOT23	844584	17856	SSTH20	2	
Q 31, 33, 35	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT-23	806463	04713	MMBT2369T	3	
Q 34	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT-23	838516	04713	MMBTH81T1	1	
Q 57	ϟ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
R 1, 28, 33, R 39, 44, 83, R 84	ϟ RES,CERM,4.7K,+-5%,.125W,200PPM,1206 ϟ ϟ	740522 740522 740522	91637	CRCW1206-4701JB02	7	
R 2	RES,CF,3K,+-5%,0.25W	810366	59124	CF1-4 VT 302 J B	1	
R 3	RES,CF,2K,+-5%,0.25W	441469	59124	CF1-4 202 J B	1	
R 6	ϟ RES,CERM,910,+-5%,.125W,200PPM,1206	769257	91637	CRCW1206-9100JB02	1	
R 7	ϟ RES,CERM,620,+-5%,.125W,200PPM,1206	745984	91637	CRCW1206-6200JB02	1	
R 9	ϟ RES,CERM,1.8,+-5%,.125W,200PPM,1206	746453	59124	RM73B-2B	1	
R 10	RES,MF,2.49K,+-1%,0.125W,100PPM	810523	59124	MF50DVT2491F REEL	1	
R 12	ϟ RES,CERM,200,+-5%,.125W,200PPM,1206	746339	91637	CRCW1206-2000JB02	1	
R 13	ϟ RES,CERM,22,+-5%,.125W,200PPM,1206	746230	91637	CRCW1206-22R0JB02	1	
R 14	RES,MF,61.9M,+-1%,0.25W,150PPM	851741	19701	5053YL61M90F	1	
R 15	RES,MF,1.21K,+-1%,0.125W,100PPM	810507	59124	MF50DVT1211F REEL	1	
R 16	ϟ RES,CER,750,+-5%,0.125W,200PPM,1206	746404	91637	CRCW1206-7500JB02	1	
R 19- 21, 29, R 31, 41, 48, R 82,115,116	ϟ RES,CERM,10K,+-5%,.125W,200PPM,1206 ϟ ϟ	746610 746610 746610	91637	CRCW1206-1002JB02	10	
R 22	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4 VT 203 J B	1	
R 23, 32	ϟ RES,CERM,10,+-5%,.125W,200PPM,1206	746214	91637	CRCW1206-10R0JB02	2	
R 24	ϟ RES,CERM,2.49K,+-1%,.125W,100PPM,1206	806448	91637	CRCW1206-2491FB02	1	
R 25	ϟ RES,CERM,51.1,+-1%,.125W,100PPM,1206	806422	91637	CRCW1206-51R1FB02	1	
R 26, 27, 70, R 89, 90	RES,MF,20K,+-0.1%,0.25W,25PPM	810564 810564	91637	CMF55 2002 B T-9	5	
R 30, 50, 85	ϟ RES,CERM,510,+-5%,.125W,200PPM,1206	746388	91637	CRCW1206-5100JB02	3	
R 36, 77, 78, R 103,105	ϟ RES,CERM,1.2K,+-5%,.125W,200PPM,1206 ϟ	746412 746412	91637	CRCW1206-1202JB02	5	
R 37,106,110	ϟ RES,CERM,12,+-5%,.125W,200PPM,1206	845458	91637	CRCW1206-12R0JB02	3	
R 38, 49	ϟ RES,CERM,270,+-5%,.125W,200PPM,1206	746354	91637	CRCW1206-2700JB02	2	
R 40	ϟ RES,CERM,100K,+-5%,.125W,200PPM,1206	740548	91637	CRCW1206-1003JB02	1	
R 43, 52,109	ϟ RES,CERM,3K,+-5%,.125W,200PPM,1206	746511	91637	CRCW1206-3001JB02	3	
R 45	ϟ RES,CERM,2.7K,+-5%,.125W,200PPM,1206	746503	91637	CRCW1206-J2700B02	1	
R 46	ϟ RES,CERM,360,+-5%,.125W,200PPM,1206	783290	91637	CRCW1206-3600JB02	1	
R 47, 60, 62, R 66, 75, 76	ϟ RES,CERM,100,+-5%,.125W,200PPM,1206 ϟ	746297 746297	91637	CRCW1206-1000JB02	6	

Table 6-12. A11 DAC PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 51	ϟ RES,CERM,150,+-1%,.125W,100PPM,1206	772780	91637	CRCW-1206-151FB02	1	
R 53, 71	ϟ RES,CERM,5.1K,+-5%,.125W,200PPM,1206	746560	91637	CRCW1206-5101JB02	2	
R 58, 59, 64, R 73,124-127	ϟ RES,CERM,56K,+-5%,.125W,200PPM,1206 ϟ	746701 746701	91637	CRCW1206-5602JB02	8	
R 61	RES,CF,1.5K,+-5%,0.25W	810432	59124	CF1-4 VT 152 J B	1	
R 63, 65, 95, R 96, 99	ϟ RES,CERM,1K,+-5%,.125W,200PPM,1206 ϟ	745992 745992	91637	CRCW1206-1001JB02	5	
R 68	RES,MF,40K,+-0.1%,0.125W,100PPM	821702	59124	MF50DVT4002B REEL	1	
R 69	RES,MF,18.12K,+-0.1%,0.125W,50PPM	734020	59124	MF50CVT18121B	1	
R 72	RES,CF,200,+-5%,0.25W	810390	59124	CF1-4 VT 201 J B	1	
R 74	ϟ RES,CERM,470K,+-5%,.125W,200PPM,1206	746792	91637	CRCW1206-4703JB02	1	
R 79- 81	ϟ RES,CERM,100K,+-1%,.125W,100PPM,1206	769802	91637	CRCW1206-104FB02	3	
R 86, 87,100	ϟ RES,CERM,330,+-5%,.125W,200PPM,1206	746370	91637	CRCW1206-3300JB02	3	
R 88	RES,MF,50K,+-0.1%,0.25W,25PPM	810580	91637	CMF55 5002 B T-9	1	
R 91	RES,MF,4.12K,+-1%,0.125W,100PPM	820381	59124	MF50DVT4121F REEL	1	
R 92, 94	ϟ RES,CERM,2K,+-5%,.125W,200PPM,1206	746461	91637	CRCW1206-2001JB02	2	
R 93	ϟ RES,CERM,8.06K,+-1%,.125W,100PPM,1206	806356	91637	CRCW1206-8061FB02	1	
R 97, 98,114	ϟ RES,CERM,22K,+-5%,.125W,200PPM,1206	746651	91637	CRCW1206-2202JB02	3	
R 104	ϟ RES,CERM,15K,+-5%,.125W,200PPM,1206	746628	91637	CRCW1206-1502JB02	1	
R 107,108	ϟ RES,CERM,1.8K,+-5%,.125W,200PPM,1206	746453	91637	CRCW1206-1801JB02	2	
R 111	RES,CF,33K,+-5%,0.25W	733667	59124	CF1-4 VT 333 J B	1	
R 112,113	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4 VT 103 J B	2	
R 117-119,123	ϟ RES,CERM,7.5K,+-5%,.125W,200PPM,1206	746586	91637	CRCW1206-7501JB02	4	
T 1	PULSE TRANSFORMER	802892	89536	802892	1	
TP 1, 3, 8- TP 10, 12	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	91984	150T1	6	
U 1	ϟ IC,OP AMP,DUAL,LO OFFST VOLT,LO-DRIFT	851704	27014	LF412ACN	1	
U 20	ϟ IC,OP AMP,DUAL,PRECISION,8-PIN DIP	783696	64155	LT1013CN8	1	
U 5	ϟ IC,OP AMP,POWER,IO=250MA	807917	27014	LM77000CP	1	
U 6	ϟ IC,CMOS,PROGRMBL INTERVAL TIMER,PLCC	806612	34371	CS82C54 T/R	1	
U 7	ϟ IC,COMPARATOR,HI-SPEED,PRECISION	822197	64155	LT1016CN8	1	
U 8	ϟ IC,CMOS,OCTL INV LINE DRVR,SOIC	782938	01295	SN74HC240DWR	1	
U 9	ϟ IC,CMOS,QUAD 2 INPUT OR GATE,SOIC	783712	01295	SN74HC32DR	1	
U 10	ϟ IC,COMPARATOR,HI-SPEED,14 PIN DIP	647115	18324	NE522N	1	
U 11	ϟ IC,OP AMP,SINGLE,LOW NOISE FAST,SOIC	783720	01295	TL071CDR	1	
U 12, 37	ϟ ISOLATOR,OPTO,LED TO TRANSISTOR,DUAL	454330	50579	ILCT-6-254	2	
U 13	ϟ ISOLATOR, 20 MHZ OPTOCOUPLER	742817	28480	HCPL-2400,OPTION 100	1	
U 14	ϟ IC,CMOS,DUAL D F/F,+EDG TRG,SOIC	782995	01295	SN74HC74DR	1	
U 15	ϟ IC,CMOS,DUAL MONOSTB MULTIVBRTR,SOIC	806620	27014	MM74HC423AM	1	
U 19	ϟ IC,OP AMP,DUAL,PRECISION MATCHED	782375	64155	OP227GN	1	
U 22	ϟ IC,OP AMP,JFET INPUT,22V SUPPLY,DIP	832584	04713	LF356BN	1	
U 23	ϟ IC,DMOS,QUAD ANALOG SWITCH,SOIC	806687	17856	SG4234T1	1	
U 24	ϟ IC,OP AMP,PRECISION,JFET INPUT	808097	64155	LT1056CN8	1	
U 25	IC,CMOS,RR A/D CONVERTER	715680	89536	715680	1	
U 26	ϟ IC,OP AMP,DUAL,LO-NOISE,8 PIN DIP	707976	18324	NE5532N	1	
U 27, 28	ϟ IC,OP AMP,DUAL,JFET IN,HIGH SPEED	855069	64155	LT1057CN8	2	
U 29, 38	ϟ IC,OP AMP,JFET INPUT,8 PIN DIP	472779	27014	LF356N	2	
U 31	ϟ IC,CMOS,PROGRAMBL PERIPH INTRFC,PLCC	806604	34371	CS82C55A T/R	1	
U 32	ϟ IC,CMOS,3-8 LINE DCDR W ENABLE,SOIC	783019	01295	SN74HC138DR	1	
U 33, 34	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	2	
U 35, 36	ϟ IC,COMPARATOR,QUAD,14 PIN,SOIC	741561	18324	LM339DT	2	
VR 1, 17, 21, VR 31, 32	ϟ ZENER,UNCOMP,20.0V,5%, 6.2MA,0.4W ϟ	810275 810275	65940	1N968BT-88	5	
VR 2, 8, 24	ϟ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W	810267	65940	1N961BT-88	3	

Table 6-12. A11 DAC PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
VR 3	ϟ ZENER,UNCOMP,16.0V,7.8MA,0.4W	822205	04713	1N966BRR1	1	
VR 4	ϟ ZENER,UNCOMP,18.0V,5%,7.0MA,0.4W	810325	65940	1N967BT-88	1	
VR 5, 19, 20, VR 35, 36	ϟ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W	820423 820423	65940	1N753AT-88	5	
VR 6, 30	ϟ ZENER,UNCOMP,12.0V,10%,10.5MA,0.4W	741074	04713	1N963A	2	
VR 7, 16	ϟ ZENER,UNCOMP,22.0V,5%,5.6MA,0.4W	811927	65940	1N969BT-88	2	
VR 10, 12	ϟ ZENER,UNCOMP,10V,5%,20MA,0.2W,SOT-23	783704	04713	MMBZ5240T1	2	
VR 11	ϟ ZENER,UNCOMP,10.0V,5%,20.0MA,0.5W	820480	65940	1N5240BT-88	1	
VR 13	ϟ ZENER,UNCOMP,13V,5%,9.5MA,0.5W	820456	04713	1N5243BRR1	1	
VR 18, 22	ϟ ZENER,UNCOMP,15.0V,5%,8.5MA,0.4W	820415	04713	1N965BRR1	2	
VR 25	ϟ ZENER,UNCOMP,3.3V,10%,20.0MA,0.4W	309799	04713	1N746	1	
VR 26	ϟ ZENER,UNCOMP,3.3V,5%,20MA,0.2W,SOT-23	807008	04713	MMBZ5226T1	1	
VR 27	ϟ ZENER,UNCOMP,7.5V,5%,20MA,0.2W,SOT-23	837138	04713	MMBZ5236BT1	1	
VR 28	ϟ ZENER,UNCOMP,8.2V,5%,20MA,0.2W,SOT-23	837146	04713	MMBZ5237T1	1	
VR 29	ϟ ZENER,COMP,6.4V,+2-3.4%,20PPM,1MA	810259	04713	SZ2475TA2	1	
VR 33, 34	ϟ ZENER,UNCOMP,7.5V,5%,20.0MA,0.4W	810291	65940	1N755AT-88	2	
X 1	SOCKET,IC,40PIN,DUAL WIPE,BEAM TYPE	756668	00779	2-641616 (-1)	1	
Z 2	ϟ RES NET THIN FILM TESTED	890244	89536	890244	1	
Z 4	RES,CERM,SIP,10 PIN,5 RES,56K,+-2%	529131	91637	CSC10A-03-563G	1	
Z 5	RES,CERM,SIP,6 PIN,5 RES,510,+-2%	459974	91637	CSC06A-01-511G	1	
Z 8	ϟ RES NET THN F TESTED	809418	89536	809418	1	
Z 10	RES NET THN F TESTED	833830	89536	833830	1	
Z 12	RES,CERM,SIP,6 PIN,5 RES,10K,+-2%	500876	91637	CSC06A-01-103G	1	
NOTES:	ϟ Static sensitive part.					



5700A-1640

Figure 6-12. A11 DAC PCA

Table 6-13. A11A1 DAC Filter SIP PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 6	CAP,POLYES,0.33UF,+-20%,50V	853903	68919	MKS02334M5	6	
C 10, 11	CAP,POLYPR,1UF,+-5%,50V,HERMETIC	783811	84411	JF136	2	
C 12, 13	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	51406	GRM42Y5U221Z50VPB	2	
C 14	CAP,CER,100PF,+-10%,50V,C0G,1206	740571	04222	12065A101KAT050R	1	
P 21, 22	HEADER,2 ROW,.100CTR,RT ANG,6 PIN	912217	0AKZ5	LPEG06DRT1R125135	2	
R 1, 2	ϟ RES,CERM,11K,+-5%,.125W,250PPM,1206	769752	91637	CRCW12061102JB02	2	
R 3, 5	ϟ RES,CERM,18K,+-5%,.125W,200PPM,1206	746636	91637	CRCW12061802JB02	2	
R 4	ϟ RES,CERM,22K,+-5%,.125W,200PPM,1206	746651	59124	RM73B2BJ2202B	1	
U 1	ϟ IC,OP AMP,ULTRA-LOW-NOISE,SOIC	783001	01295	OP07CDR	1	
U 2	ϟ IC,OP AMP,PRECISION,LOW NOISE	782920	64155	LT1007CN8	1	
VR 1	ϟ ZENER,UNCOMP,15.0V,5%,8.5MA,0.4W	698704	04713	IN965B-SR4348RL	1	
NOTES:	ϟ Static sensitive part.					

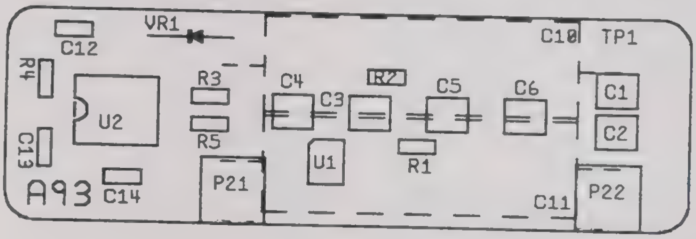


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Figure 6-13. A11A1 DAC Filter SIP PCA

Table 6-14. A11A2 DAC Buffered Reference SIP PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 5	CAP,CER,10PF,+-10%,100V,C0G,1206	806943	51406	GRMM42-6C0G100F100PT	2	
C 2, 3	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	51406	GRM42Y5U221Z50VPB	2	
C 4, 6	CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	04222	12065A1001KAT050R	2	
P 11	HEADER,2 ROW,.100CTR,RT ANG,10 PIN	658112	00779	87230-5	1	
P 12	HEADER,2 ROW,.100CTR,RT ANG,8 PIN	424200	00779	87230-4	1	
Q 1- 15	⚡ TRANSISTOR,SI,N-JFET,HI-VOLTAGE,TO-92	832147	17856	J2907-TR3	15	
R 1, 6- 8	⚡ RES,CERM,1K,+-5%,.125W,200PPM,1206	745992	59124	RM73B2BJ102B	4	
R 5	⚡ RES,CERM,10,+-5%,.125W,200PPM,1206	746214	09969	CRCW1206100JBO2	1	
R 9	⚡ RES,CERM,100K,+-1%,.125W,100PPM,1206	769802	59124	RK73H2BF104B	1	
U 1	⚡ IC,OP AMP,DUAL,PRECISION,8-PIN DIP	783696	64155	LT1013CN8	1	
U 2	⚡ IC,OP AMP,DUAL,LO-NOISE,8 PIN DIP	707976	18324	NE5532N	1	
VR 1	⚡ ZENER,UNCOMP,22.0V,5%,5.6MA,0.4W	181073	04713	1N969B	1	
Z 1	RES,CERM,SIP,10 PIN,5 RES,56K,+-2%	529131	91637	CSC10A-03-563G	1	
Z 2	RES,CERM,SIP,6 PIN,5 RES,51K,+-2%	514042	91637	CSC06A-03-513G	1	
NOTES:	⚡ Static sensitive part.					

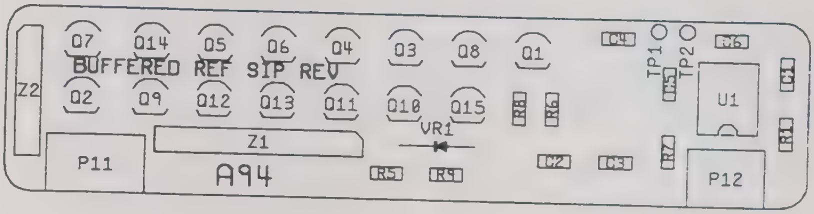

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Figure 6-14. A11A2 DAC Buffered Reference SIP PCA

Table 6-15. A12 Oscillator Control PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1- 4, 12, C 14, 16, 18, C 48	CAP,TA,4.7UF,+-20%,25V	807644 807644 807644	56289	199D475X0025BA1	9	
C 8, 10	CAP,AL,2.2UF,+-20%,50V,SOLV PROOF	769687	62643	KM50VB2R2M45X85LL	2	
C 21	CAP,CER,10PF,+-10%,3000V,C0G	817049	60705	564CTK302EE100K	1	
C 22, 25	CAP,TA,330UF,+-20%,3V	385963	56289	196D337X0004TE4	2	
C 23, 24, 36- C 38, 44- 47, C 49, 50, 56, C 57, 61, 64, C 65, 67, 68, C 70- 72, 76- C 81	CAP,POLYES,0.22UF,+-5%,50V	747519 747519 747519 747519 747519 747519 747519	60935	185.22J0050RCB	27	
C 26, 29, 30, C 42, 60	CAP,POLYES,0.47UF,+-10%,50V	697409 697409	84411	J1320R47MF10PCT50V	5	
C 27, 28, 31, C 43, 63	CAP,POLYES,0.047UF,+-10%,50V	820548 820548	60935	185-2/473K0050RAB	5	
C 33, 58, 59	CAP,CER,120PF,+-5%,50V,C0G	721142	04222	SR215A121JAT	3	
C 34, 35, 86, C 87	CAP,TA,47UF,+-20%,20V	822403 822403	62643	KME50T47RM6X11RP	4	
C 39, 53	CAP,CER,330PF,+-5%,50V,C0G	697441	04222	SR215A331JAT	2	
C 40, 41	CAP,TA,10UF,+-20%,25V	714774	56289	199D106X0025CA1	2	
C 51, 52, 66	CAP,CER,82PF,+-2%,50V,C0G	714857	04222	SR215A821GAT	3	
C 54	CAP,CER,3.3PF,+0.25PF,100V,C0J	816678	04222	SR211C0J3R3CAA	1	
C 55	CAP,CER,6.8PF,+-0.25PF,50V,C0G	715243	51406	RPE122C0G689K50V	1	
C 62	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	1	
C 69, 90, 91	CAP,POLYES,0.01UF,+-10%,50V	715037	60935	185/.01K0050RGB	3	
C 74	CAP,CER,3300PF,+-5%,50V,C0G	830612	04222	SR215A332JAT	1	
C 75, 88	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 82, 85	CAP,POLYES,0.022UF,+-10%,50V	715268	60935	185-2/.022K0050RCB	2	
C 83	CAP,CER,150PF,+-10%,50V,X7R	682377	04222	SR215C151CAA	1	
C 84	CAP,POLYPR,0.47UF,+-10%,160V	446807	60935	171/.47K160H	1	
CR 1- 3	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	03508	1N4448	3	
CR 4, 5	⚡ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	408815	28480	HP5082-6265	2	
CR 6- 8	⚡ DIODE,SI,BV= 75.0V,IO=150MA,500MW	698720	65940	1N4448	3	
CR 12- 15	⚡ DIODE,SI,BV= 70.0V,500 MW	851910	07263	1N4606	4	
H 4- 7	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 13	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	1	
HS 1	HEAT DIS,RAD,.54X1.25X.35,TO-8	808204	13103	2268B	1	
K 1	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	1	
K 2- 9	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VCH284	8	
L 1- 4	CHOKE,6TURN	320911	89536	320911	4	
M 12	OSCILLATOR THERMAL COVER	797696	89536	797696	1	
MP 8, 9	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 10	SHIELD, HIGH VOLTAGE CONTROL	761197	89536	761197	1	
MP 14	SPACER,TRANSISTOR MOUNT,DAP,TO-5	837823	07047	10014	1	
P 501,502	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2T5	2	
Q 1	⚡ TRANSISTOR, SI, 100V, 1W, CASE 152-02	806497	04713	MPSU07	1	
Q 2	⚡ TRANSISTOR, SI, 100V, 1W, CASE 152-02	806489	04713	MPSU57	1	
Q 3	⚡ TRANSITOR,SI,PNP,SMALL SIG,SELECTED	851977	04713	SPS9432RLRA	1	
Q 4	⚡ TRANSISTOR,SI,NPN SMALL SIGNAL	853478	04713	MPSH10RLRA	1	
Q 5, 9, 11	⚡ TRANSISTOR,SI,N-JFET,TO-92	832162	27014	JF832162	3	
Q 6, 7, 12, Q 18, 20	⚡ TRANSISTOR,SI,N-CHAN,TO-92,SWITCH ⚡	832139 832139	17856	J2903	5	
Q 8, 13	⚡ TRANSITOR,SI,N-JFET,UHF/VHF USE	851972	27014	J310	2	
Q 10	⚡ TRANSISTOR,SI,P-MOS,ZENER PROTECTED	306142	21845	M5141	1	
Q 14	⚡ TRANSISTO,SI,NMOS,1W,4 PIN DIP	853692	17856	V12948	1	

Table 6-15. A12 Oscillator Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Q 19	⚡ TRANSISTOR,SI,N-DMOS FET,TO-72	394122	18324	SD210EE	1	
R 1, 2, 55	RES,CF,30K,+-5%,0.25W	574251	65940	R25J303	3	
R 3	RES,MF,143K,+-1%,0.125W,100PPM	719641	59124	MF55D1433F	1	
R 4, 12	RES,CF,3K,+-5%,0.25W	573279	59124	CF1-4302JB	2	
R 5, 13, 25, R 48, 52, 53, R 68, 69	RES,CF,1K,+-5%,0.25W	573170 573170 573170	59124	CF1-4102JB	8	
R 6	RES,CF,750,+-5%,0.25W	810374	59124	CF1-4VT751J	1	
R 7	RES,CF,200,+-5%,0.25W	810390	59124	CF1-4VT201J	1	
R 8- 10	RES,MF,113K,+-1%,0.125W,100PPM	291302	91637	CMF551133F T-1	3	
R 11	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4VT203J	1	
R 14	RES,CF,22K,+-5%,0.25W	573451	59124	CF1-4223JB	1	
R 15	RES,CF,5.1K,+-5%,0.25W	573329	59124	CF1-4512JB	1	
R 16	RES,CF,15,+-5%,0.25W	641043	59124	CF1-4150JB	1	
R 17, 39	RES,CF,510,+-5%,0.25W	573139	59124	CF1-4511JB	2	
R 18	RES,CF,47,+-5%,0.25W	822189	59124	CF1-4VT470J	1	
R 19	RES,CF,10,+-5%,0.25W	807669	59124	CF1-4VT100J	1	
R 20	RES,MF,301K,+-1%,0.125W,25PPM	379156	91637	CMG-553013F T-9	1	
R 21	RES,CF,2K,+-5%,0.25W	573238	59124	CF1-4202JB	1	
R 22, 24, 29, R 66	RES,CF,100K,+-5%,0.25W	573584 573584	59124	CF1-4104JB	4	
R 23, 30, 33	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	3	
R 26	RES,MF,316K,+-1%,0.125W,100PPM	720078	91637	CMF-553163F T-1	1	
R 27, 28	RES,CF,1K,+-5%,0.25W	780585	59124	CF1-4VT102J	2	
R 31, 37, 45	RES,MF,866,+-0.1%,0.125W,50PPM	838441	91637	CMF-558660B T-2	3	
R 32, 50	RES,CF,120,+-5%,0.25W	643494	59124	CF1-4121JB	2	
R 34	RES,MF,3.61K,+-0.25%,0.25W,100PPM	832394	59124	MF55D3611C	1	
R 35, 36, 40, R 41	RES,MF,649K,+-1%,0.125W,100PPM	721597 721597	91637	CMF-556493F T-1	4	
R 38, 42	RES,MF,357K,+-1%,0.125W,25PPM	312793	91637	CMF-3573F T-9	2	
R 43, 63- 65	RES,CF,20K,+-5%,0.25W	573444	59124	CF1-4203JB	4	
R 44	RES,CF,2.2K,+-5%,0.25W	573246	59124	CF1-4222JB	1	
R 46	RES,CF,12K,+-5%,0.25W	573402	59124	CF1-4123JB	1	
R 47	RES,CF,560,+-5%,0.25W	573147	59124	CF1-4561JB	1	
R 49, 54, 56	RES,CF,10K,+-5%,0.25W	573394	59124	CF1-4103JB	3	
R 57	RES,MF,60.4K,+-1%,0.125W,100PPM	720425	91637	CMF-556042F T-1	1	
R 58	RES,MF,1K,+-1%,0.125W,100PPM	719468	91637	CMF-551001F T-1	1	
R 62	RES,CF,4.7K,+-5%,0.25W	573311	59124	CF1-4472JB	1	
R 67	RES,MF,562K,+-1%,0.125W,100PPM	757815	59124	MF50DVT5623F	1	
R 70	RES,CF,1K,+-5%,0.25W	780585	59124	CF1/4102J	1	
TP 1- 8	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	1SOT1	8	
U 1, 3	⚡ IC,OP AMP,50MHZ,CURRENT FEEDBACK AMP	836262	64762	EL2020CN	2	
U 2, 7	⚡ IC,OP AMP,HI-SLEW RATE,8 PIN DIP	386268	27014	LM318N	2	
U 5, 26	⚡ IC,OP AMP,LO-OFFSET VOLTAGE,LO-NOISE	605980	06665	OP-07DP	2	
U 8, 19	⚡ IC,CMOS,QUAD BILATERAL SWITCH	910708	17856	DG2444CJ	2	
U 9	⚡ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495192	27014	LF353N	1	
U 10	⚡ IC,CMOS,14BIT DAC,12BIT ACC,CUR OUT	773101	24355	AD7534KN	1	
U 11, 30, 31	⚡ IC,OP AMP,PRECISION,LOW NOISE	782920	64155	LT1007CN8	3	
U 12	⚡ IC,OP AMP,DUAL,PRECISION MATCHED	782375	64155	OP227GN	1	
U 13	⚡ IC,OP AMP,JFET INPUT,WIDE BANDWIDTH	808105	64762	EL2006CG	1	
U 14, 16	RMS CONVERTER TESTED 400 OHM-A GRADE	842591	89536	842591	2	
U 15	⚡ IC,OP AMP,QUAD JFET INPUT,14 PIN DIP	659748	01295	TL074CN	1	
U 17	⚡ IC,ARRAY,5 TRANS,NPN,3 ISO,2 DIFF CON	248906	04713	MC3346P	1	
U 18	⚡ IC,CMOS,8-1 LINE MUX DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	

Table 6-15. A12 Oscillator Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 20	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 21, 22	ϟ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	2	
U 23, 24	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	2	
U 25	ϟ IC,VOLT REG,FIXED,+5 VOLTS,1.5 AMPS	428847	04713	MC7805T	1	
VR 1, 2	ϟ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W	698696	04713	1N748	2	
VR 3	ϟ ZENER,UNCOMP,5.1V,5%,20MA,0.4W	722926	04713	1N751A	1	
VR 4	ϟ ZENER,UNCOMP,6.8V,2%,175.0MA,5.0W	325845	04713	1N5342C	1	
VR 5, 6	ϟ ZENER,UNCOMP,6.8V,5%,37.0MA,1.0W	454595	14552	1N4736A	2	
Z 1	ϟ RES,NET,THK F,	760686	89536	760686	1	
Z 2, 4	ϟ RNET,8840A OUTPUT DIVIDER	655811	89536	655811	2	
Z 3	ϟ RES, NET, THN F FINAL TEST	760645	89536	760645	1	
Z 5	RES,CERM,DIP,14 PIN,7 RES,10K,+-5%	364000	89536	364000	1	
Z 6	RES,CERM,SIP,8 PIN,7 RES,1K,+-2%	414557	91637	CSC08A-01-102G	1	
Z 7, 8	ϟ RES NET THK F,	785105	89536	785105	2	
Z 9	RES,CERM,DIP,16 PIN,8 RES,5.1K,+-5%	544130	91637	MDP16-03-512J	1	
Z 10	RES,CERM,SIP,8 PIN,4 RES,4.7K,+-2%	573881	91637	CSC08A-03-102G	1	
NOTES:	ϟ Static sensitive part.					

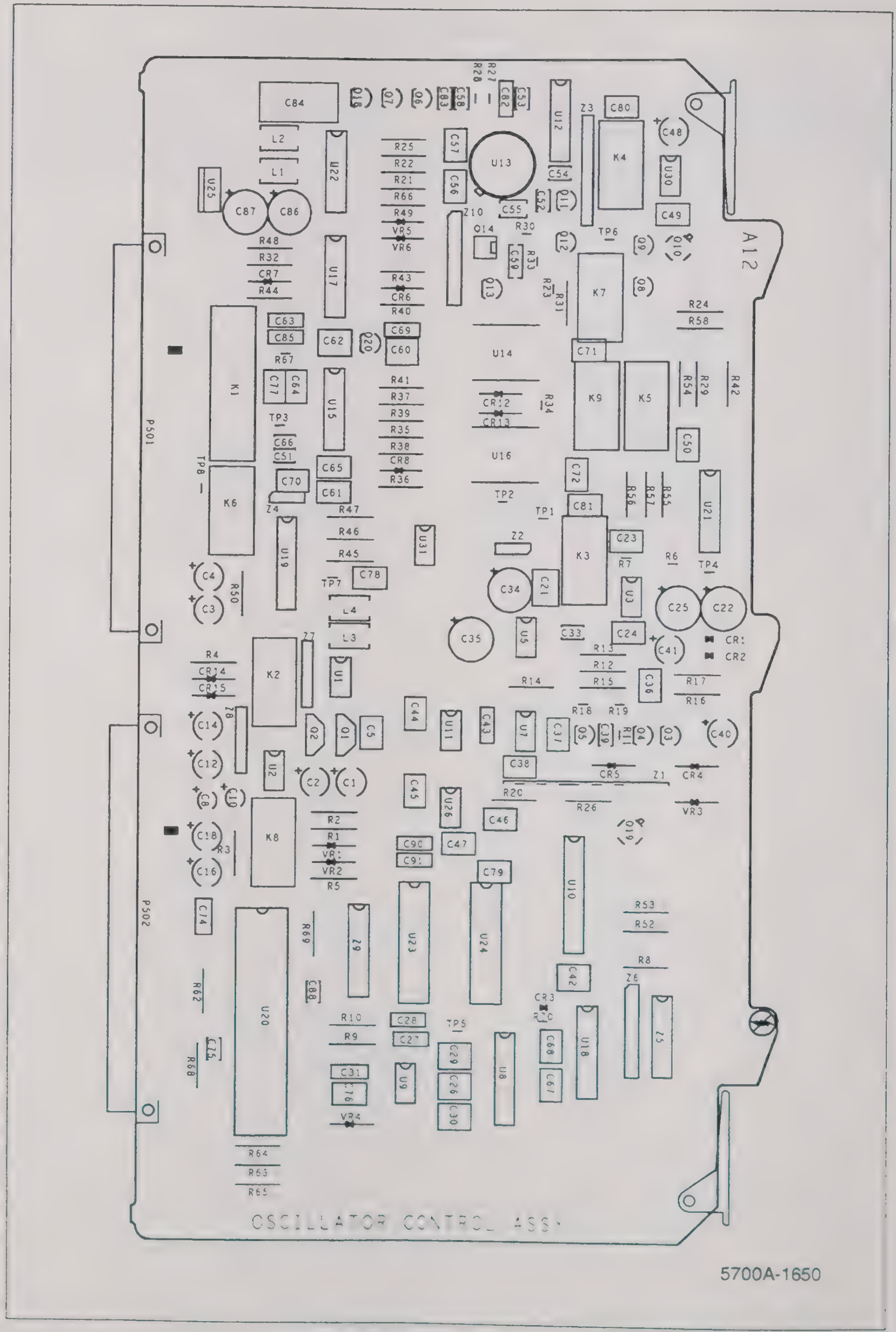

Figure 6-15. A12 Oscillator Control PCA

Table 6-16. A13 Oscillator Output PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	OSCILLATOR WIDEBAND SMD PCA				1	1
C 2- 4, 16, C 20, 23, 26- C 28, 32, 33, C 46, 47, 51, C 52, 54, 55, C 68- 71, 88- C 92,102-104, C 110,111,113, C 114	CAP,POLYES,0.22UF,+-5%,50V	747519 747519 747519 747519 747519 747519 747519 747519 747519	60935	185.22/J/0050/R/C/B	33	
C 5, 14, 30	CAP,CER,15PF,+-20%,50V,C0G	697524	04222	SR215A150MAT	3	
C 6, 15, 31	CAP,CER,82PF,+-2%,50V,C0G	714857	04222	SR215A150MAT	3	
C 7, 8	CAP,CER,0.01UF,+-10%,100V,X7R	557587	04222	SR21C103MAT	2	
C 17, 29	CAP,CER,2.7PF,+-0.25PF,50V,C0G	773044	51406	RPE122C0G279K50V	2	
C 19, 34, 85	CAP,CER,56PF,+-2%,50V,C0G	714378	04222	SR215A560GAT	3	
C 21, 37	CAP,MICA,560PF,+-1%,300V	494609	93790	CD15FC561F0	2	
C 22, 38	CAP,POLYCA,6150PF,+-1%,50V	800466	84411	JF 125	2	
C 24, 40	CAP,POLYCA,0.0621UF,+-1%,50V	800482	84411	JF 152	2	
C 25, 41	CAP,POLYCA,0.622UF,+-1%,50V	800474	84411	JF 125	2	
C 44,123	CAP,CER,10PF,+-20%,50V,C0G	721589	04222	SR215A100MAT	2	
C 45	CAP,POLYPR,0.033UF,+-10%,63V	721050	68919	MKP20-336-K-63V	1	
C 48, 84	CAP,AL,10UF,+-20%,16V,NP,SOLV PROOF	697177	62643	KME-BP16VB10RM5X11RP	2	
C 49	CAP,AL,470UF,+-20%,10V,SOLV PROOF	822387	62643	KME10VB471M8X11RP	1	
C 56- 59	CAP,TA,22UF,+-20%,10V	658971	56289	199D226X0010CA1	4	
C 60, 61,108, C 109	CAP,TA,4.7UF,+-20%,25V	807644 807644	56289	199D475X0025BA1	4	
C 62	CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	1	
C 75	CAP,CER,120PF,+-5%,50V,C0G	721142	04222	SR215A121JAT	1	
C 76, 77,124, C 125	CAP,CER,1000PF,+-20%,50V,X7R	697458 697458	89536	697458	4	
C 78, 79	CAP,POLYES,0.01UF,+-10%,50V	715037	60935	185-.01-K-0050-R	2	
C 80, 81	CAP,POLYES,0.1UF,+-10%,50V	649913	60935	185-2/0.1K0050RAB	2	
C 82, 83	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	2	
C 93- 99,106, C 107	CAP,TA,10UF,+-20%,25V	714774 714774	56289	199D106X0025CA1	9	
C 100,101,118	CAP,AL,2.2UF,+-20%,50V,SOLV PROOF	769687	62643	KM50VB2R2M45X85LL	3	
C 105	CAP,CER,3300PF,+-5%,50V,C0G	830612	04222	SR215A332JAT	1	
C 112	CAP,CER,4.7PF,+-0.25PF,50V,C0G	721837	51406	RPE122C0G479K50V	1	
C 115	CAP,CER,6800PF,+-5%,100V,C0G	816710	04222	SR211A682JAA	1	
C 119,120	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 122	CAP,CER,27PF,+-2%,100V,C0G	816652	04222	SR211A270GAT	1	
CR 1- 11, 22, CR 23	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED ⚡	659516 659516	03508	1N4448	13	
CR 13- 20	⚡ DIODE,SI,N-JFET,CURRENT REG,IF=5.3 MA	852116	17856	J9010-TR3	8	
H 4- 7	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 9- 12	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	4	
HS 1- 3	HEAT DIS,RAD,.54X1.25X.35,TO-8	808204	13103	2268B	3	
HS 4- 7	HEAT DIS,CLIP,.80X.85X.30,CASE 152	800136	13103	6046PB	4	
HS 9, 10	HEAT DIS,SLEEVE,TO-5	380220	13103	1115B	2	
HS 58	HEAT DIS,VERT,.83X.50X.395,TO-5	800144	13103	2272B	1	
K 1	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	1	
K 2- 4	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VH284	3	
L 1- 5, 13, L 14	CHOKE,6TURN	320911 320911	89536	320911	7	
L 6- 12	CORE,TOROID,FERRITE,.047X.138X.118	321182	02114	56-590-65-4B	7	
L 15	TRANSFORMER, PULSE	660589	89536	660589	1	
MP 1	OSCILLATOR HEAT SINK RETAINER	775296	89536	775296	1	

Table 6-16. A13 Oscillator Output PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
MP 2, 3	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 4- 6	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	3	
MP 8	AIR DUCT, OSCILLATOR	802959	89536	802959	1	
MP 9	TAPE,SPONGE,SILICONE,W/LINER,.125X.5W	853387	71643	100S-1/8-500	2	
MP 13- 15	SPACER,TRANSISTOR MOUNT,DAP,TO-5	837823	07047	10014	3	
P 511,512	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 6	⚡ TRANSISTOR,SI,N-JFET,TO-92	832162	27014	JF832162	1	
Q 7	⚡ TRANSISTOR,SI,N-DMOS FET,TO-72	394122	18324	SD210DE	1	
Q 8	⚡ TRANSISTOR,SI,NPN,SM SIGNAL,HI-FREQ	272930	04713	2N5943	1	
Q 9	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	04713	2N3904RLRA2	1	
Q 10, 11	⚡ TRANSISTOR, SI, 100V, 1W, CASE 152-02	806497	04713	MPSU07	2	
Q 13	⚡ TRANSISTOR,SI,NPN,HI-CURRENT	402602	04713	MRF531	1	
Q 14	⚡ TRANSISTOR,SI,PNP,SMALL SIG,RF,TO-39	800201	04713	2N5583	1	
Q 15	⚡ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
Q 16, 17	⚡ TRANSISTOR, SI, 100V, 1W, CASE 152-02	806489	04713	MPSU57	2	
R 1, 6, 43, R 60, 65	RES,MF,2K,+-1%,0.125W,100PPM	816629 816629	59124	MF50DVT2001F	5	
R 2, 40, 64 R 67, 69	RES,CF,1K,+-5%,0.25W	780585 780585	59124	CF1-4VT102J	9	
R 7, 9, 11, R 18	RES,CF,200,+-5%,0.25W	810390 810390	59124	CF1-4VT201J	4	
R 12, 13, 83	RES,MF,4.99K,+-1%,0.125W,100PPM	721548	59124	MF55D4991F	3	
R 19, 37, 50, R 70, 79	RES,CF,10K,+-5%,0.25W	697102 697102	59124	CF1-4VT103J	5	
R 25	RES,CF,39K,+-5%,0.25W	912621	59124	CF1/4 393J	1	
R 33, 38, 51, R 78	RES,CF,16K,+-5%,0.25W	714303 714303	59124	CF1-4VT163J	4	
R 28	RES,MF,1K,+-1%,0.125W,100PPM	816595	59124	MF50DVT1001F	1	
R 29, 62, 68	RES,MF,10K,+-1%,0.125W,100PPM	719476	91637	CMF551002FT-1	3	
R 32	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4VT203J	1	
R 35, 36, 47, R 52, 53, 59, R 63, 74, 75, R 80- 82,107	RES,CF,4.7K,+-5%,0.25W	721571 721571 721571 721571	59124	CF1-4VT472J	13	
R 39, 54, 76	RES,CF,12K,+-5%,0.25W	757799	59124	CF1-4VT123J	3	
R 41	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	1	
R 42	RES,MF,10.5K,+-1%,0.125W,100PPM	816611	59124	MF50DVT1052F	1	
R 48	RES,CF,51K+-5%,0.25W	747550	59124	CF1-4VT513J	1	
R 49	RES,CF,270,+-5%,0.25W	810424	59124	CF1-4VT271J	1	
R 55, 77	RES,CF,24K,+-5%,0.25W	697599	59124	CF1/4 243J	2	
R 56	RES,MF,34.8K,+-0.1%,0.125W,50PPM	772582	59124	MF50CVT3482B	1	
R 57	RES,CF,43K,+-5%,0.25W	821777	59124	CF1-4VT433J	1	
R 58	RES,CF,47K,+-5%,0.25W	721787	59124	CF1-4VT473J	1	
R 61, 66	RES,MF,7.87K,+-1%,0.125W,100PPM	810549	59124	MF50DVT7871F	2	
R 71, 73	RES,CF,3K,+-5%,0.25W	810366	59124	CF1-4VT302J	2	
R 84, 85	RES,CF,33K,+-5%,0.25W	733667	59124	CF1-4VT333J	2	
R 87, 94	RES,CF,100,+-5%,0.25W	810465	59124	CF1-4VT101J	2	
R 88	RES,CF,4.7,+-5%,0.25W	816637	59124	CF1-4VT4R7J	1	
R 89, 90, 97, R 98	RES,CF,10,+-5%,0.25W	807669 807669	59124	CF1-4VT100J	4	
R 91, 99	RES,CF,2.7,+-5%,0.25W	640953	59124	CF1-42R7J	2	
R 92, 93, 95, R 96	RES,CF,3.9,+-5%,0.25W	810473 810473	59124	CF1-4VT3R9J	4	
R 100,101	RES,MF,30.1K,+-1%,0.125W,100PPM	772061	59124	MF50DVT3012F	2	
S 1	SWITCH,SLIDE,SPDT	477984	79727	GF-11	1	
TP 1- 10	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	10	

Table 6-16. A13 Oscillator Output PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 2	ϟ IC,VOLT REG,FIXED,-12 VOLTS,1.5 AMPS	381665	04713	MC7912CT	1	
U 3, 6, 9	ϟ IC,OP AMP,JFET INPUT,WIDE BANDWIDTH	808105	64762	EL2006CG	3	
U 5, 7, 11	ϟ RES NET HYBRID, TESTED	793885	89536	793885	3	
U 8, 29	ϟ IC,OP AMP,HI-SLEW RATE,8 PIN DIP	386268	27014	LM318N	2	
U 10	ϟ IC,MULTIPLIER/DIV,4 QUAD,10MHZ,DIP	904714	24355	AD734BN	1	
U 15, 16, 19	ϟ IC,BPLR,FOUR-QUADRANT MULT,16 PIN DIP	343335	04713	MC1494L	3	
U 12, 32, 33	ϟ IC,CMOS,OCTL D F/F W/3-STATE,+EDG TRG	585364	04713	MC74HCT374N	3	
U 17, 27	ϟ IC,CMOS,DUAL 4-1 LINE MUX/DMUX ANL SW	429886	04713	MC14052BCP	2	
U 18	ϟ IC,OP AMP,JFET INPUT,8 PIN DIP	472779	27014	LF356N	1	
U 20	ϟ IC,COMPARATOR,DUAL,LO-PWR,8 PIN DIP	478354	27014	LM393N	1	
U 21	ϟ IC,FTTL,QUAD 2 INPUT NAND GATE	654640	04713	MC74F00N	1	
U 22	ϟ IC,FTTL,DUAL JK F/F,-EDG TRIG	781211	18324	74F112N	1	
U 23	ϟ IC,COMPARATOR,DUAL,HI-SPEED,14 DIP	647123	27014	LM319N	1	
U 24	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	1	
U 25	ϟ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
U 26	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 28	ϟ IC,CMOS,DUAL 8 BIT DAC,CURRENT OUTPUT	722272	24355	AD7528JN	1	
U 31	ϟ IC,OP AMP,DUAL,JFET INPUT,8 PIN DIP	495192	27014	LF353N	1	
VR 3, 4	ϟ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W	810267	14552	DZ810317D	2	
VR 7	ϟ ZENER,UNCOMP,8.2V,5%,20MA,0.4W	810309	04713	1N756ARR1	1	
Z 1	RES,CERM,SIP,6 PIN,5 RES,39K,+-2%	831065	91637	CSC06A-01-393G	1	
Z 2	RES,CERM,DIP,14 PIN,7 RES,10K,+-5%	364000	91637	MDP14-03-103J	1	
Z 3	RES,CERM,SIP,8 PIN,7 RES,1K,+-2%	414557	91637	CSC08A-01-102G	1	
Z 4, 5	RES,CERM,SIP,8 PIN,4 RES,10K,+-2%	513309	91637	CSC08A-03-103G	2	
Z 6	RES,CERM,SIP,6 PIN,5 RES,3.6K,+-2%,	478818	91637	CSC06A-01-362G	1	
NOTES:	ϟ Static sensitive part. 1. NON PROCURABLE. ORDER NEXT HIGHER ASSEMBLY.					

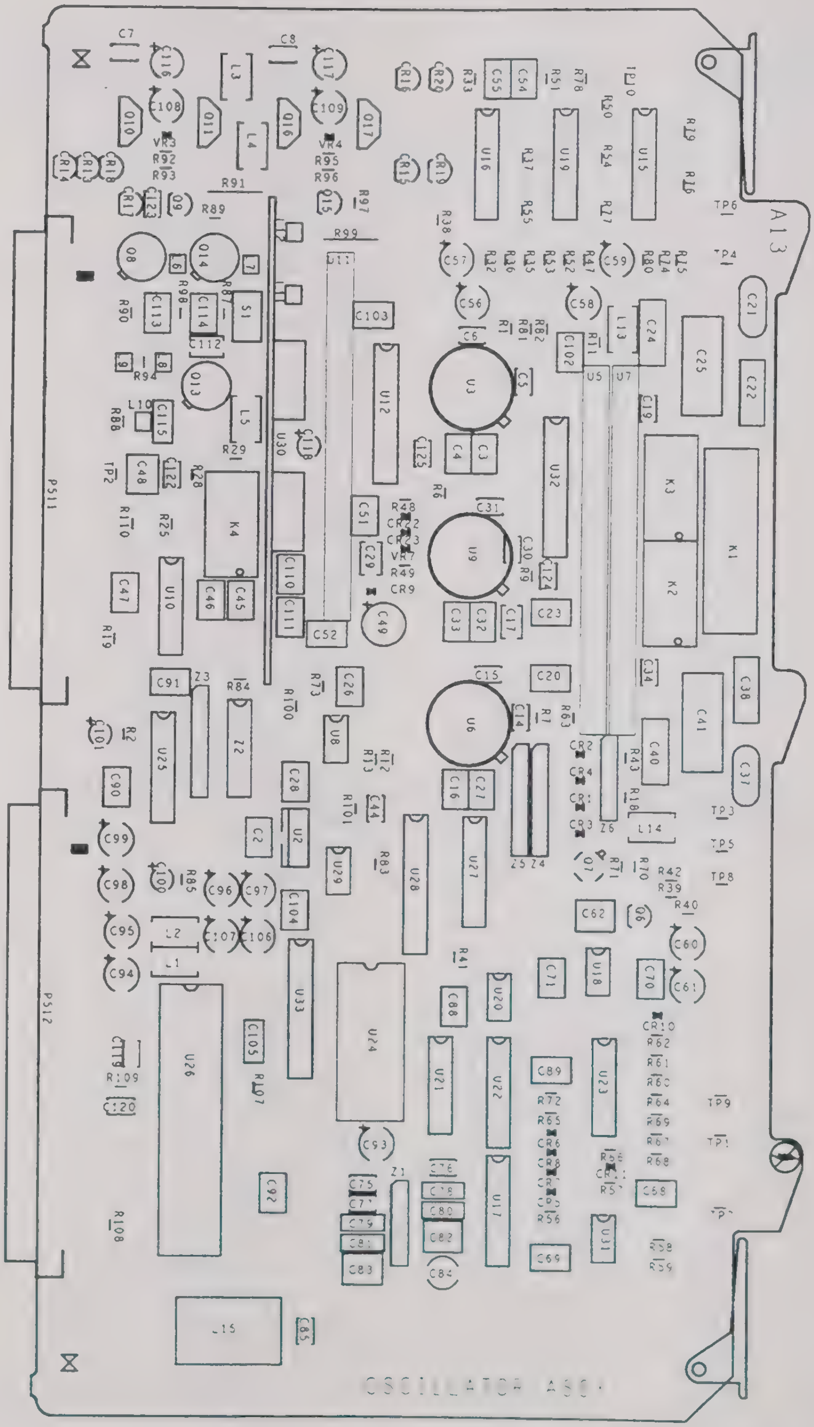

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Figure 6-16. A13 Oscillator Output PCA

Table 6-17. A13A1 Oscillator Wideband SMD PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 3, 4, C 6- 8, 12, C 13	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597 740597 740597	51406	GRM42Y5U221Z50VPB	8	
C 2	CAP,CER,100PF,+-10%,50V,C0G,1206	740571	04222	12065A101KAT050R	1	
C 5	CAP,CER,10PF,+-10%,100V,C0G,1206	806943	51406	GRMM426C0G100F100PT	1	
C 9	CAP,CER,470PF,+-10%,50V,C0G,1206	747360	04222	12065A471KAT050R	1	
C 10	CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	04222	12065A1001KAT050R	1	
C 11	CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	04222	12065C103KAT060R	1	
CR 4- 6, 9 CR 10	ϟ DIODE,SI,BV=70.0V,IO=50MA,DUAL,SOT23	742320 742320	02114	BAV99	5	
P 1, 2	HEADER,2 ROW,.100CTR,RT ANG,12 PIN	806935	22526	68715-412	2	
Q 1	ϟ TRANSISTOR,SI,N-JFET,SOT23	844584	17856	SSTH20	1	
Q 2, 4, 5, Q 7	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	845438 845438	04713	MMBTH10	4	
Q 3	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	742684	04713	MMBT3906T1	1	
Q 6, 8	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	838516	04713	MMBTH81T1	2	
Q 9	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	742676	04713	MMBT3904T1	1	
R 1, 9	ϟ RES,CERM,2K,+-5%,.125W,200PPM,1206	746461	59124	RM73B2BJ202J	2	
R 2	ϟ RES,CERM,2.7K,+-5%,.125W,200PPM,1206	746503	91637	CRCW1206J2700B02	1	
R 3, 22	ϟ RES,CERM,330,+-5%,.125W,200PPM,1206	746370	59124	RM73B2BJ331B	2	
R 4, 26	ϟ RES,CERM,510,+-5%,.125W,200PPM,1206	746388	59124	RM73B2BJ511B	2	
R 5	ϟ RES,CERM,5.1K,+-5%,.125W,200PPM,1206	746560	59124	RM73B2BJ512KB	1	
R 6, 23, 31	ϟ RES,CERM,3.9K,+-5%,.125W,200PPM,1206	746545	91637	CRCW12063900JB02	3	
R 7, 16, 18, R 19, 21, 27- R 29	ϟ RES,CERM,47,+-5%,.125W,200PPM,1206	746263 746263 746263	59124	RM73B2BJ470B	8	
R 8	ϟ RES,CERM,100K,+-5%,.125W,200PPM,1206	740548	59124	RM73B2BJ100KB	1	
R 10	ϟ RES,CERM,56,+-5%,.125W,200PPM,1206	807727	91637	CRCW1206560JB02	1	
R 11, 17	ϟ RES,CERM,150,+-1%,.125W,100PPM,1206	772780	91637	CRCW1206151FB02	2	
R 12	ϟ RES,CERM,27,+-5%,.125W,200PPM,1206	807735	59124	RM73B2BJ270B	1	
R 13	ϟ RES,CERM,100,+-5%,.125W,200PPM,1206	746297	59124	RM73B2BJ101B	1	
R 14	ϟ RES,CERM,620,+-5%,.125W,200PPM,1206	745984	09969	CRCW1206621JB02	1	
R 15	ϟ RES,CERM,15K,+-5%,.125W,200PPM,1206	746628	59124	RM73B2BJ153B	1	
R 20	ϟ RES,CERM,390,+-5%,.125W,200PPM,1206	740498	91637	CRCW1206391JB02	1	
R 24	ϟ RES,CERM,910,+-5%,.125W,200PPM,1206	769257	59124	RM73B2BJ911B	1	
R 25	ϟ RES,CERM,1.8K,+-5%,.125W,200PPM,1206	746453	59124	RM73B2BJ182B	1	1
R 30	RES,VAR,CERM,1K,+-10%,0.5W	912360	32997	3296P-1-102	1	
U 1	ϟ IC,OP AMP,ULTRA-LOW-NOISE,SOIC	783001	01295	OP07CDR	1	
U 2	ϟ IC,OP AMP,SINGLE,LOW NOISE FAST,SOIC	783720	01295	TL071CDR	1	
VR 1, 5- 7	ϟ ZENER,UNCOMP,6.2V,5%,20MA,.35W,SOT23	782441	04713	MMBZ5234BT1	4	
VR 2	ϟ ZENER,UNCOMP,22.0V,5%,5.6MA,SOT23	831230	04713	MMBZ5251BT1	1	
VR 3, 4	ϟ ZENER,UNCOMP,3.3V,5%,2MA,.350W,SOT23	807008	04713	MMBZ5226T1	2	
NOTES:	ϟ Static sensitive part. 1. R25 is selected at test as one of the following: 1.8K (746453), 2K (746461, or 2.2K 746479)					

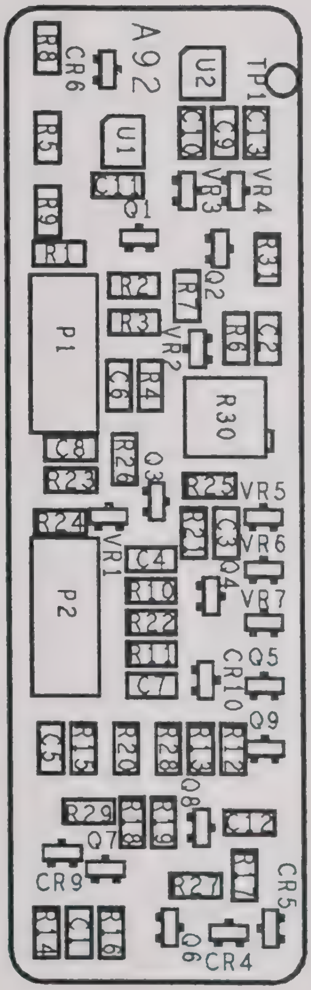

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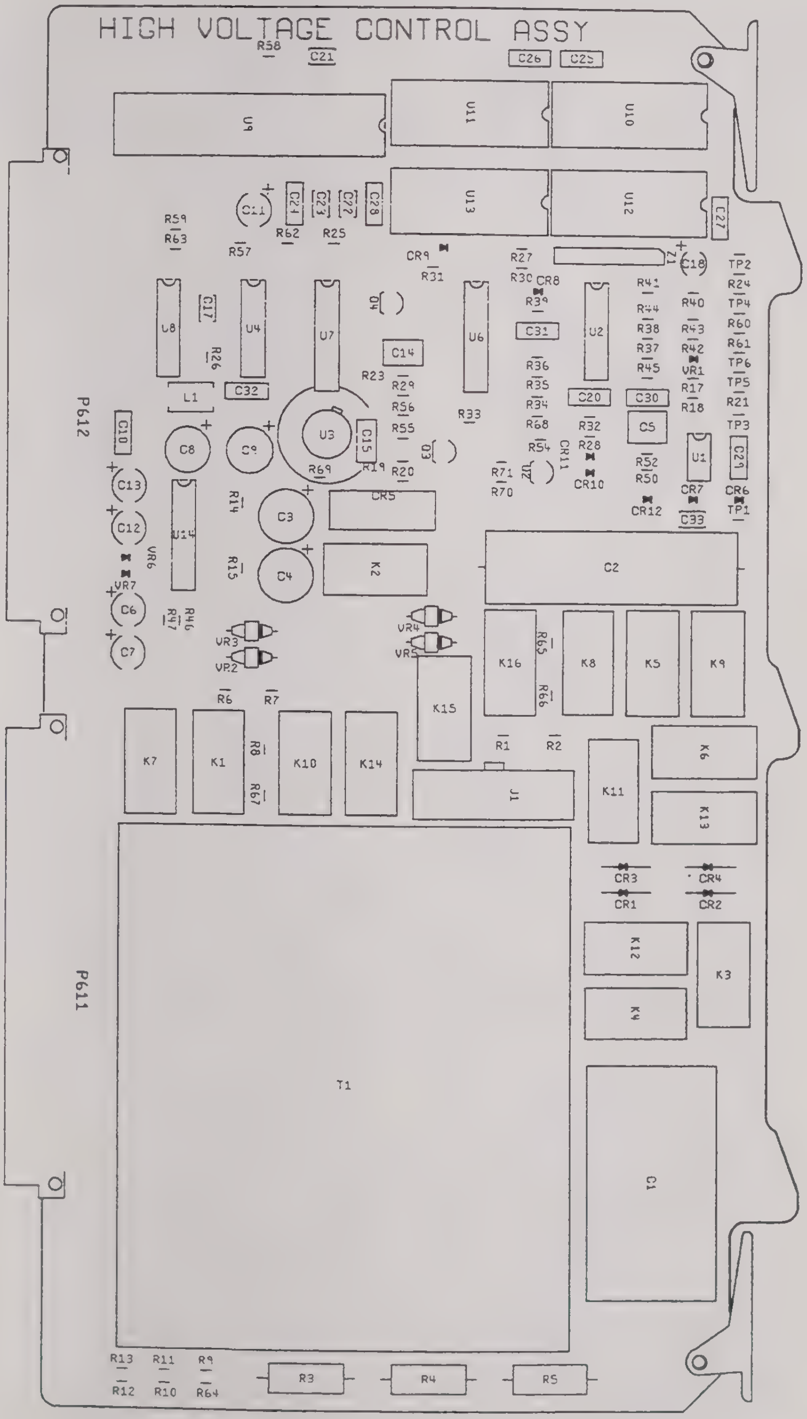
Figure 6-17. A13A1 Oscillator Wideband SMD PCA

Table 6-18. A14 High Voltage Control PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,POLYES,0.72UF,+-20%,1300V	853929	84411	JF154	1	
C 2	CAP,POLYES,0.1UF,+-20%,1400V	821512	84411	JF129	1	
C 3, 4	CAP,AL,470UF,+-20%,16V,SOLV PROOF	772855	61058	ECEA1CU471	2	
C 5	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00/K0050RGB	1	
C 6, 7	CAP,TA,10UF,+-20%,35V	816512	56289	199D106X9035DA1	2	
C 8, 9	CAP,TA,10UF,+-20%,63V	816843	62643	KME63T10RMX11RP	2	
C 10, 20, 24- C 32	CAP,POLYES,0.1UF,+-10%,50V	649913 649913	60935	185-2/0.1K0050RAB	11	
C 11- 13	CAP,TA,22UF,+-20%,10V	658971	56289	199D226X0010CA1	3	
C 14	CAP,CER,330PF,+-5%,50V,C0G	697441	04222	SR21A5331JAT	1	
C 15	CAP,CER,120PF,+-5%,50V,C0G	721142	04222	SR215A121JAT	1	
C 17	CAP,POLYES,2200PF,+-10%,50V	832683	60935	185-2/2200K0050RAB	1	
C 18	CAP,TA,1UF,+-20%,35V	697417	56289	199D105X0035AA1	1	
C 21, 22	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 23	CAP,CER,1000PF,+-20%,50V,X7R	697458	89536	697458	1	
C 33	CAP,CER,27PF,+-2%,100V,C0G	816652	04222	SR211A270GAT	1	
CR 1- 4	ϟ DIODE,SI,HIGH VOLTAGE,PIV=2K,40MA	851956	14099	PF20.TR	4	
CR 5	DIODE,SI,RECT,BRIDGE,BV= 50V,IO=3.0A	586115	30800	KBL005	1	
CR 6- 12	ϟ DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	03508	1N4448	7	
H 4- 7	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 8, 9, 11	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	3	
J 1	CONN,MATE-N-LOK,HEADER,14 PIN	845318	27264	39-28-8140	1	
K 1, 2, 4, K 8, 10, 11, K 14	RELAY,ARMATURE,2 FORM C,5V	733063 733063 733063	33297	MR602-5SR	7	
K 3, 5, 6, K 9, 12, 13, K 15, 16	RELAY,ARMATURE,1 FORM A/1 FORM B,5VDC	831545 831545 831545	61529	DSP1E-DC5V	8	
K 7	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VH284	1	
L 1	CHOKE,6TURN	320911	89536	320911	1	
MP 1, 2	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 3	SHIELD, HIGH VOLTAGE CONTROL	761197	89536	761197	1	
MP 5	CABLE ACCESS,TIE,5.50L,.10W,1.25 DIA	530360	06383	SST-1.5M	1	
MP 8	HEAT DIS,PRESS ON,TO-5	418384	13103	2225B	1	
MP 10, 13	WASHER,FLAT,STL,.149,.375,.031	110270	86928	5202-12-31	2	
P 611,612	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 2	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	04713	2N3904RLRA2	1	
Q 3, 4	ϟ TRANSISTOR,SI,P-JFET,TO-92	852111	17856	J6006-TR3	2	
R 1, 2	RES,CC,47,+-5%,0.5W	159608	01121	EB4705	2	
R 3- 5	RES,CC,200K,+-5%,1W	109926	01121	GB2041	3	
R 6, 8, 65, R 66	RES,CF,10,+-5%,0.25W	807669 807669	59124	CF1-4VT100JB	4	
R 7	RES,CF,22K,+-5%,0.25W	747535	59124	CF1-4VT223J	1	
R 9- 12, 64	RES,CF,1.5M,+-5%,0.25W	649962	59124	CF1-4VT155J	5	
R 13	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	1	
R 14, 15	RES,CF,620,+-5%,0.25W	810408	59124	CF1-4VT621J	2	
R 17, 46, 55	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	3	
R 18	RES,CF,1K,+-5%,0.25W	780585	59124	CF1-4VT102J	1	
R 19	RES,MF,162K,+-1%,0.125W,100PPM	817569	59124	MF50DVT1623F	1	
R 20	RES,MF,412K,+-1%,0.125W,50PPM	714287	59124	MF50CVT4123FT	1	
R 21, 24, 33, R 34, 47, 56, R 68, 69	RES,CF,10K,+-5%,0.25W	697102 697102 697102	59124	CF1-4VT103J	8	
R 23	RES,CF,200K,+-5%,0.25W	681841	59124	CF1-4VT204J	1	
R 25	RES,CF,750K,+-5%,0.25W	747543	59124	CF1-4VT754J	1	

Table 6-18. A14 High Voltage Control PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 26, 44, 45	RES,MF,100K,+-1%,0.125W,100PPM	757807	59124	MF50DVT1003F	3	
R 27, 29	RES,MF,36.5K,+-1%,0.125W,100PPM	820324	59124	MF50DVT3652F	2	
R 28	RES,MF,20.5K,+-1%,0.125W,100PPM	655233	59124	MF50DVT2052F	1	
R 30- 32	RES,MF,18.2K,+-1%,0.125W,100PPM	756429	59124	MF50DVT1822F	3	
R 35- 39, 50, R 52	RES,MF,196K,+-1%,0.125W,100PPM	769984 769984	59124	MF50DVT1963F	7	
R 40, 41	RES,MF,464K,+-1%,0.125W,100PPM	772020	59124	MF50DVT4643F	2	
R 42	RES,CF,1.5K,+-5%,0.25W	810432	59124	CF1-4VT152J	1	
R 43	RES,MF,301K,+-1%,0.125W,100PPM	655274	59124	MF50DVT3013F	1	
R 54	RES,CF,2K,+-5%,0.25W	810457	59124	CF1-4VT202J	1	
R 57, 58	RES,CF,750,+-5%,0.25W	810374	59124	CF1-4VT751J	2	
R 59	RES,CF,16K,+-5%,0.25W	714303	59124	CF1-4VT163J	1	
R 60, 61	RES,CF,20K,+-5%,0.25W	697110	59124	CF1-4VT203J	2	
R 62, 63	RES,CF,3K,+-5%,0.25W	810366	59124	CF1-4VT302J	2	
R 67	RES,CF,3.9,+-5%,0.25W	810473	59124	CF1-4VT3R9J	1	
R 70, 71	RES,CC,4.7M,+-5%,0.25W	220046	01121	CB4775	2	
T 1	TRANSFORMER, HIGH VOLTAGE	775288	89536	775288	1	
TP 1- 6	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	1SOT1	6	
U 1	⚡ IC,OP AMP,DUAL,LO OFFST,VOLT,LO-DRIFT	685164	27014	LF412CN	1	
U 2	⚡ IC,OP AMP,QUAD,JFET INPUT,14 PIN DIP	483438	01295	TL084CN	1	
U 3	⚡ IC,OP AMP,SINGLE,HIGH VOLTAGE	782342	34371	HA2-2645-5	1	
U 4	⚡ IC,CMOS,MONOSTABL/ASTABL MULTIVIBRATR	535575	54590	CD4047BE	1	
U 6, 7	⚡ IC,CMOS,QUAD BILATERAL SWITCH	910708	17856	DG444CJ	2	
U 8	⚡ IC,CMOS,HEX INVERTER,UNBUFFERED	741199	04713	MC74HCU04N	1	
U 9	⚡ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 10- 13	⚡ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	4	
U 14	⚡ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
VR 1	⚡ ZENER,UNCOMP,6.8V,5%,20.0MA,0.4W	820431	04713	1N754ARR1	1	
VR 2, 3	⚡ DIODE,TRANS SUPPRESSOR,400V,5%	845003	24444	1N6456A	2	
VR 4, 5	⚡ ZENER,UNCOMP,16.0V,5%,15.5MA,1.0W	313221	04713	1N4745ARL	2	
VR 6, 7	⚡ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W	820423	04713	1N746ARR1	2	
Z 1	RES,CERM,SIP,8 PIN,7 RES,10K,+-2%	412924	91637	CSC08A-01-103G	1	
NOTES:	⚡ Static sensitive part.					



5700A-1661

Figure 6-18. A14 High Voltage Control PCA

Table 6-19. A15 High Voltage/High Current PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 2, 22, 29, C 42	CAP,POLYES,0.01UF,+-10%,50V	715037 715037	60935	185-2/.01K0050R	4	
C 4	CAP,POLYPR,0.022UF,+-5%,1500V	806968	40402	MKP1841-322/134	1	
C 5, 15- 17, C 20, 21, 23- C 28, 32, 33, C 35, 38, 40	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913	60935	185-2/0.1K0050RAB	17	
C 6	CAP,POLYES,0.047UF,+-10%,50V	820548	60935	185-2/473K0050RAB	1	
C 7	CAP,CER,180PF,+-2%,50V,C0G	820522	04222	SR215A181GAT	1	
C 8	CAP,CER,680PF,+-5%,50V,C0G	743351	04222	SR215A681JAT	1	
C 10	CAP,CER,82PF,+-2%,50V,C0G	714857	04222	SR215A820GAT	1	
C 11	CAP,CER,47PF,+-20%,50V,C0G	706705	04222	SR215A470MAT	1	
C 12, 13, 43	CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	3	
C 14, 19	CAP,TA,2.2UF,+-10%,35V	697433	56289	199D225X9035BF	2	
C 18	CAP,CER,100PF,+-5%,50V,C0G	831495	04222	SR225A101JAT	1	
C 30, 31, 37, C 39	CAP,TA,10UF,+-20%,35V	816512 816512	56289	199D106X9035DA1	4	
C 34	CAP,TA,22UF,+-20%,10V	658971	56289	199D226X0010CA1	1	
C 41	CAP,POLYES,0.22UF,+-10%,50V	706028	60935	185-2/.22/K0050RCB	1	
CR 1, 4, 11- CR 16	ϟ DIODE,SI,BV= 75.0V,IO=150MA,500MW ϟ	698720 698720	65940	1N4448	8	
CR 5, 6, 9, CR 10, 22, 23	DIODE,SI,100 PIV,1.0 AMP	742874 742874	65940	1N4002A	6	
CR 2, 17, 18, CR 20, 21	ϟ DIODE,SI,N-JFET,CURRENT REG,IF=5.3 MA ϟ	852116 852116	17856	J9010-TR3	5	
CR 19	ϟ DIODE,SI,N-JFET,CURRENT REG,IF=1.0 MA	852124	17856	J9004-TR3	1	
CR 24,25	DIODE,SI,BV=75.0V,10=150MA,500 MW	698720	65940	1N4448	2	
H 1, 2	SCREW,MACH,PH,P,STL,6-32,.500	152173		COMMERCIAL	2	
H 4	ϟ HYBRID ASSEMBLY, TESTED	813444	89536	813444	1	
H 6- 10, 21	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	6	
H 17- 20	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
HR 7	ϟ HIGH VOLTAGE DC HYBRID	775254	89536	775254	1	
K 1	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	1	
K 2, 3	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VH284	2	
K 4, 5, 8, K 9, 12	RELAY,ARMATURE,2 FORM C,5V	733063 733063	33297	MR602-5SR	5	
K 6, 7, 10, K 11, 14	RELAY,ARMATURE,1 FORM A/1 FORM B,5VDC	831545 831545	61529	DSP1E-DC5V	5	
L 4, 5	CHOKE,6TURN	320911	89536	320911	2	
MP 1, 2	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 3	SHIELD, HIGH VOLTAGE, REAR	791921	89536	791921	1	
MP 4	MOLDED COVER, REFERENCE HYBRID	797746	89536	797746	1	
MP 5	MOLDED COVER, HYBRID, R-NET	775619	89536	775619	1	
MP 6- 9	INSERT,STANDOFF,BROACH,SNAP TOP,1.062	832469	24347	KSSA-156-34	4	
MP 10	THERMAL INSULATOR, HIGH VOLTAGE	797829	89536	797829	1	
MP 22	HIGH VOLTAGE CLAMP BAR	760850	89536	760850	1	
P 601,602	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 3, 13	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	346916	07263	2N2219A	2	
Q 4, 15, 22, Q 23	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL ϟ	698225 698225	04713	2N3904RLRA2	4	
Q 6, 12	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	402586	04713	2N2905A	2	
Q 8, 18	ϟ TRANSISTOR,SI,BV=40V,40W,TO-220	369660	04713	TIP32T	2	
Q 9, 19	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP102T	2	
Q 10	ϟ TRANSISTOR,SI,P-JFET,TO-92	852111	17856	J6006-TR3	1	
Q 11	ϟ TRANSISTOR,SI,BV=100V, 2W,TO-220	454041	04713	MJE15029	1	
Q 14	ϟ TRANSISTOR,SI,BV=100V, 40W,TO-220	454033	04713	MJE15028	1	

Table 6-19. A15 High Voltage/High Current PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Q 16, 24	⚡ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	2	
Q 20, 21	⚡ TRANSISTOR,SI,N-JFET,LOW IGSS,RAD T&R	707703	27014	SX53025	2	
R 1, 72	RES,CF,1K,+-5%,0.25W	573170	59124	CF1-4102JB	2	
R 2, 15, 39	RES,CF,100K,+-5%,0.25W	573584	59124	CF1-4104JB	3	
R 4, 11, 51, R 53, 61- 64, R 74	RES,CF,100,+-5%,0.25W	573014 573014 573014	59124	CF1-4101JB	9	
R 5	RES,CF,1.5K,+-5%,0.25W	810432	59124	CF1-4VT152J	1	
R 6, 9	RES,CF,1M,+-5%,0.25W	573691	59124	CF1-4105JB	2	
R 7	RES,CF,51K+-5%,0.25W	747550	59124	CF1-4VT513J	1	
R 8, 19	RES,CF,3K,+-5%,0.25W	573279	59124	CF1-4302JB	2	
R 10	RES,CF,820,+-5%,0.25W	574970	59124	CF1-4821JB	1	
R 12	RES,CF,33K,+-5%,0.25W	733667	59124	CF1-4VT333J	1	
R 13	RES,MF,34.8K,+-1%,0.125W,100PPM	772319	59124	MF50DVT3482F	1	
R 14, 16, 21, R 27, 28, 40, R 44, 52, 54, R 71	RES,CF,10K,+-5%,0.25W	573394 573394 573394 573394	59124	CF1-4103JB	10	
R 17, 41	RES,CF,4.7K,+-5%,0.25W	573311	59124	CF1-4472JB	2	
R 18	RES,CF,22K,+-5%,0.25W	573451	59124	CF1-4223JB	1	
R 20	RES,CF,1.5K,+-5%,0.25W	573212	59124	CF1-4152JB	1	
R 22	RES,CF,16K,+-5%,0.25W	641118	59124	CF1-4163JB	1	
R 23, 24, 60, R 65	RES,CF,10,+-5%,0.25W	572941 572941	59124	CF1-4100JB	4	
R 25, 26	RES,MF,14.3,+-1%,0.125W,100PPM	832097	91637	CMF5514R3F T-1	2	
R 29, 30	RES,CF,8.2K,+-5%,0.25W	573378	59124	CF1-4822JB	2	
R 31, 32	RES,CC,2K,+-5%,0.5W	169854	01121	EB2025	2	
R 33- 35	RES,CC,470,+-10%,0.5W	108415	01121	EB4711	3	
R 36	RES,CF,47,+-5%,0.25W	572982	59124	CF1-4470JB	1	
R 37, 38	RES,MF,825,+-1%,0.125W,100PPM	294892	91637	CMF558250F T-1	2	
R 42, 43, 45, R 46	RES,MF,10K,+-1%,0.125W,100PPM	719476 719476	91637	CMF551002F T-1	4	
R 47	RES,CF,160,+-5%,0.25W	641084	59124	CF1-4161JB	1	
R 48, 50	RES,MF,2.21K,+-1%,0.125W,100PPM	347476	91637	CMF552211F T-1	2	
R 56, 69	RES,MF,191,+-1%,0.125W,100PPM	719799	91637	CMF551910F T-1	2	
R 57, 68, 77, R 78	RES,WW,.1,+-3%,.7W	255679 255679	05347	MS2N1011R0H	4	
R 58, 67	RES,CF,330K,+-5%,0.25W	641159	59124	CF1-4334JB	2	
R 59, 66	RES,CF,68,+-5%,0.25W	643783	59124	CF1-4680JB	2	
R 73, 75	RES,CF,2K,+-5%,0.25W	573238	59124	CF1-4202JB	2	
R 76	RES,CF,3.3,+-5%,0.25W	348730	59124	CF1-43R3JB	1	
R 79, 82	RES,CF,1K,+-5%,0.25W	780585	59124	CF1-4VT102J	2	
R 80, 83	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	2	
R 81, 84	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4VT103J	2	
TP 1, 3- 11	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	10	
TP 2	SOCKET,SINGLE,PWB,FOR 0.080 PIN	170480	74970	105-752	1	
U 1	⚡ IC,OP AMP,JFET INPUT,22V SUPPLY,DIP	832584	04713	LF356BN	1	
U 2, 4, 5	⚡ IC,OP AMP,JFET INPUT,8 PIN DIP	472779	27014	LF356N	3	
U 3	⚡ IC,OP AMP,DUAL,LO OFFST,VOLT,LO-DRIFT	685164	27014	LF412CN	1	
VR 1, 2, 5, VR 6	⚡ ZENER,UNCOMP,16.0V,5%,15.5MA,1.0W ⚡	313221 313221	04713	1N4745ARL	4	
VR 3, 4	⚡ ZENER,UNCOMP,20.0V,5%,6.2MA,0.4W	832576	04713	1N968B	2	
VR 7, 8	⚡ ZENER,UNCOMP,16.0V,5%,7.8MA,0.4W	698712	04713	1N966B-SR4348RL	2	
W 1	HIGH VOLTAGE CABLE ASSEMBLY,8.0"	881859	89536	881859	1	
W 2	HIGH VOLTAGE CABLE ASSEMBLY,9.25"	881862	89536	881862	1	
W 3	HIGH VOLTAGE CABLE ASSEMBLY,7.75"	881867	89536	881867	1	

Table 6-19. A15 High Voltage/High Current PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Z 5	ϟ R-NET/HEAT SINK ASSY-4R03	761288	89536	761288	1	
Z 6	ϟ R-NET/HEAT SINK ASSY-4R23	761296	89536	761296	1	
NOTES:	ϟ Static sensitive part.					

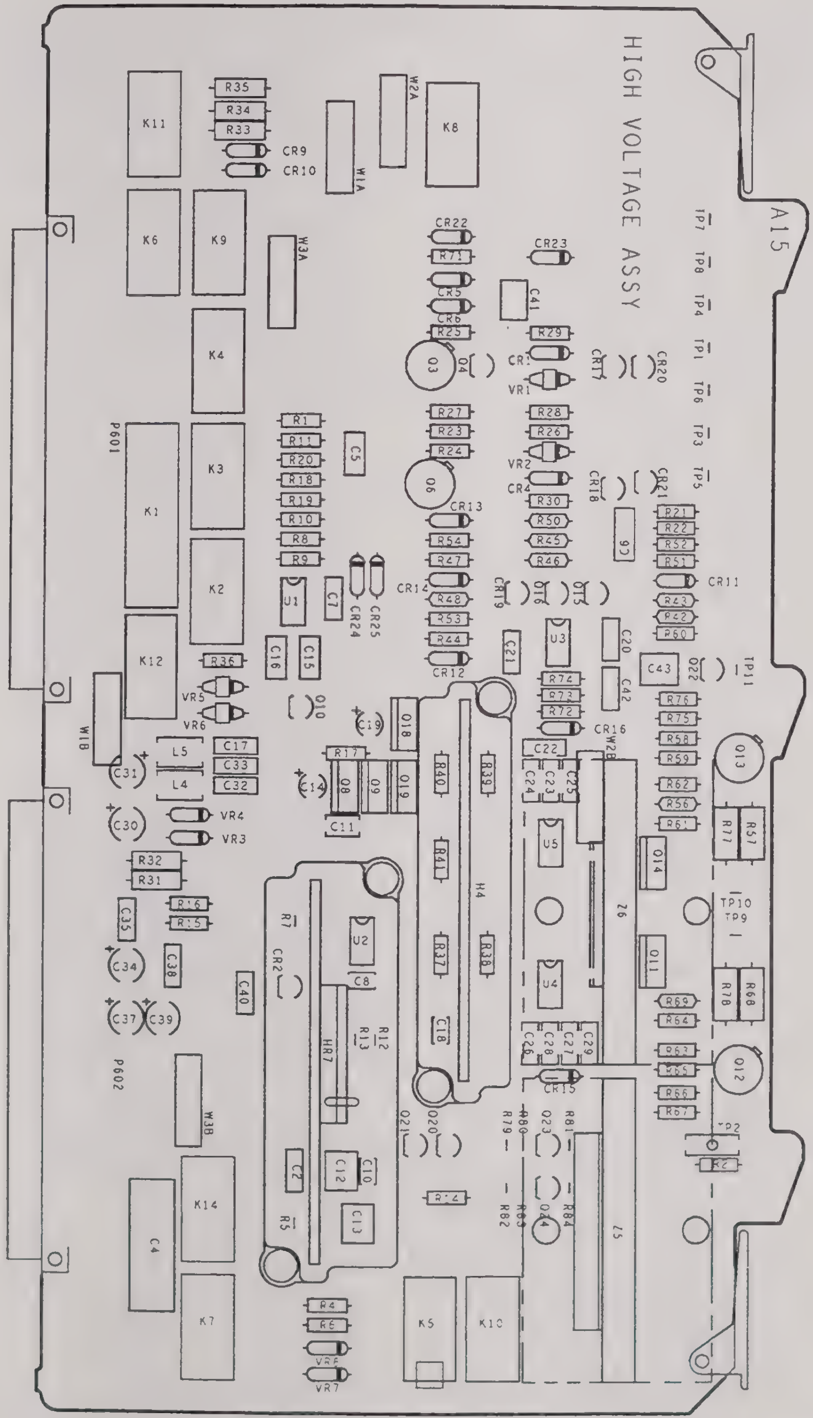


Figure 6-19. A15 High Voltage/High Current PCA

Table 6-20. A16 Power Amplifier PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
A 1	POWER AMP DIGITAL CONTROL SIP PCA	775320	89536	775320	1	
C 1, 2, 63	CAP,CER,10PF,+-10%,3000V,C0G	817049	60705	564CTK302EE100K	3	
C 3	CAP,MICA,560PF,+-5%,500V	170431	93790	CD19FD561J0	1	
C 4, 28	CAP,CER,0.02UF,+-20%,500V,Z5U	407403	56289	562CZ5UAA501AJ203	2	
C 5, 75	CAP,POLYES,0.47UF,+-10%,50V	820548	60935	185-2/473K0050RAB	2	
C 6, 17, 23	CAP,CER,22PF,+-10%,1000V,C0G	817023	60705	561CC0GRE102EE220K	3	
C 7, 24, 43	CAP,CER,1000PF,+-20%,50V,X7R	697458	89536	697458	3	
C 8, 13, 16, C 20, 47, 49, C 60, 61, 68- C 71	CAP,POLYES,0.22UF,+-5%,50V	747519 747519 747519 747519	60935	185.22/J0050RCB	12	
C 9, 21	CAP,TA,15UF,+-20%,20V	807610	56289	199D156X0020DA1	2	
C 10, 25	CAP,TA,1UF,+-20%,35V	697417	56289	199D105X0035AA1	2	
C 11	CAP,CER,22PF,+-2%,50V,C0G	714832	04222	SR215A220GAT	1	
C 12	CAP,CER,2000PF,+-20%,100V,Z5U	757096	51406	DD10X-90B	1	
C 15	CAP,CER,0.01UF,+80-20%,500V,Z5U	816991	60705	562CZ5URE501AG103Z	1	
C 18	CAP,CER,6.8PF,+-0.1PF,500V,C0J	485383	59660	831-085-C0J0-689B	1	
C 19	CAP,CER,100PF,+-5%,50V,C0G	831495	31433	C330C101J5G5CA	1	
C 22	CAP,MICA,2PF,+-0.5PF,500V	175208	93790	CD19CD19CD020D0	1	
C 26	CAP,CER,1000PF,+-20%,3000V,Z5U	832709	60705	564CZ5UTK302EE102M	1	
C 27, 78, 79	CAP,AL,3.3UF,+30-20%,450V,SOLV PROOF	782524	62643	SM450VB3R3M12X24LDV	3	
C 31- 34	CAP,AL,22UF,+-20%,35V,SOLV PROOF	817056	62643	KMA35T220M6X7FT	4	
C 40	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00/K0050RGB	1	
C 41	CAP,POLYPR,0.15UF,+-10%,400V	557504	84411	JF150	1	
C 42	CAP,CER,470PF,+-10%,50V,C0G	733071	04222	SR215A100GAT	1	
C 45	CAP,TA,2.2UF,+-10%,35V	697433	31433	T356E225K035AS	1	
C 48, 72	CAP,CER,1.2PF,+-0.25PF,50V,M7J	715235	59660	8101-50-M7J-129B	2	
C 57	CAP,CER,100PF,+-10%,1000V,S3N	816983	60705	561CR3LRE102EF101K	1	
C 65, 67	CAP,TA,4.7UF,+-20%,25V	807644	56289	199D475X0025BA1	2	
C 73	CAP,CER,0.05UF,+80-20%,500V,Z5U	105676	60705	562CBZ501AK503ZA32	1	
C 74	CAP,POLYES,0.1UF,+-10%,50V	649913	60935	185-2/0.1K0050RAB	1	
C 80, 81	CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	2	
C 82	CAP,CER,10PF,+-2%,50V,C0G	713875	72982	RPE122-901C0G100G50V	1	
CR 1, 2, 7, CR 10, 12- 14, CR 16, 20, 21, CR 23- 25, 27, CR 29- 31, 61- CR 67	ϟ DIODE,SI,BV= 75.0V,RADIAL INSERTED ϟ ϟ ϟ ϟ ϟ	659516 659516 659516 659516 659516 659516	03508	1N4448	25	
CR 3, 4	DIODE,SI,BV=75V,IO=150MA,500MW	203323	09214	1N4448	2	
CR 8, 9	DIODE,SI,100 PIV,1.0 AMP	820449	65940	1N4002A-T20(A)	2	
CR 18, 19	ϟ DIODE,SI,BV=125.0V,IO=150MA,500 MW	844647	07263	FDH300	2	
CR 33, 68	ϟ DIODE,SI,N-JFET,CURRENT REG,IF=5.3 MA	852116	17856	J9010-TR3	2	
CR 35- 39	DIODE,SI,BV=200V,IO=200MA	876867	07263	FDH400	5	
CR 53	ϟ DIODE,SI,N-JFET,CURRENT REG,IF=1.0 MA	334839	17856	J9013	1	
H 1, 2	SCREW,PH,P,LOCK,SS,6-32X0.500	320051	2M530	320051	2	
H 3, 4	SCREW,MACH,PH,P,STL,6-32X0.750	114223		COMMERCIAL	2	
H 10, 48, 59, H 60	SCREW,MACH,PH,P,STL,6-32X0.375	334458 334458		COMMERCIAL	4	
H 13- 16	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
HR 8	ϟ POWER AMP DC HYBRID	775437	89536	775437	1	
K 1, 2	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	2	
K 3, 4	RELAY,ARMATURE,2 FORM C,5V,LATCH	769307	61529	DS2EML2DC5VH264	2	
K 10, 11, 13- K 16	RELAY,ARMATURE,2 FORM C,5V	733063 733063	33297	MR601-5SR	6	
K 12, 17	RELAY,ARMATURE,2 FORM C,5V	911271	33297	MR601-5USR	2	

Table 6-20. A16 Power Amplifier PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
L 1- 3	CHOKE,6TURN	320911	89536	320911	3	
L 10	INDUCTOR,1.5UH,+-5%,128MHZ,SHLD	413856	89536	413856	1	
L 12	CHOKE,2TURN	417196	89536	417196	1	
M 17	OSCILLATOR THERMAL COVER	797696	89536	797696	1	
MP 3	AIR DUCT DIVIDER, PWR AMP	791939	89536	791939	1	
MP 4	MOLDED COVER, HYBRID, R-NET	775619	89536	775619	1	
MP 5- 8	HEAT DIS,PRESS ON,TO-5	418384	13103	2225B	4	
MP 9- 12	RIVET,POP,DOME,AL,.125X.316	807347	0CLN7	AD42H	4	
MP 20- 23	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	4	
MP 43, 44	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 45- 47,	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	3	
MP 49	HEATSINK, POWER AMP	803007	89536	803007	1	
MP 50	SHIELD, HIGH VOLTAGE, REAR	791921	89536	791921	1	
MP 51- 54	INSUL PART,TRANSISTOR,NYL,.4,.61,.14	844837	06915	IEC-TO-220-18	4	
MP 55	THERMAL INSULATOR, POWER AMP	791988	89536	791988	1	
MP 56, 57	POWER AMP CLAMP BAR	803015	89536	803015	2	
MP 58	AIR DUCT, PWR AMP	775601	89536	775601	1	
P 701,702	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-50D2TB	2	
Q 1, 3	ϟ TRANSISTOR,SI,N-MOS,30W,500V,TO-220	782540	04713	MTP2N50	2	
Q 2	ϟ TRANSITOR,SI,N-JFET,UHF/VHF USE	851972	27014	J310	1	
Q 4, 7, 32, Q 60, 62 ϟ	ϟ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225 698225	04713	2N3904RLRA2	5	
Q 5	ϟ TRANSISTOR,SI,NPN,HI-FREQ,TO-39	912522	04713	MRF544	1	
Q 6	ϟ TRANSISTOR,SI,PNP,SMALL SIGNAL	844993	55464	MPS6522	1	
Q 8	ϟ TRANSISTOR,SI,N-DMOS FET,TO-72	394122	18324	SD210EE	1	
Q 9, 16, 54	ϟ TRANSISTOR,SI,NPN SMALL SIGNAL	853478	04713	MPSH10RLRA	3	
Q 10	ϟ TRANSISTOR,SI,PNP,70V,400MA,TO-39	866769	04713	MRF545	1	
Q 11	ϟ TRANSISTOR,SI,PNP,SWITCHING,TO-92	831446	04713	MPS3640RLRA	1	
Q 12, 14	ϟ TRANSISTOR,SI,N-DMOS,400V,TO-39	783753	59640	VN0550N2	2	
Q 13	ϟ TRANSISTOR,SI,P-MOS,500V,TO-92	782508	59640	VP0550N3	1	
Q 15, 17	ϟ TRANSISTOR,SI,P-MOS,POWER,500VT0220AB	782482	04713	MTP2P50	2	
Q 31	ϟ TRANSISTOR,SI,VMOS,PWR,TO-237,VN10KM	640516	17856	V11809	1	
Q 33, 34	ϟ TRANSISTOR,SI,N-JFET,LOW IGSS,RAD T&R	707703	27014	SX53025	2	
Q 35	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	04713	TIP12T	1	
Q 38	ϟ TRANSISTOR,SI,BV=40V,40W,TO-220	369660	04713	TIP32T	1	
Q 39, 40, 50, Q 51, 57, 58	ϟ TRANSISTOR,SI,N-DMOS PWR FET,TO-92 ϟ	782565 782565	59640	VN0104N3	6	
Q 61	ϟ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
R 1	RES,CF,9.1K,+-5%,0.25W	706663	59124	CF1-4VT912J	1	
R 2, 18, 54, R 56, 89, 90, R 134,135	RES,CF,10K,+-5%,0.25W	697102 697102 697102	59124	CF1-4 VT 103J	8	
R 3, 4, 81- R 83	RES,MF,100K,+-0.1%,0.5W,50PPM	369371 369371	19701	5053RC1003B	5	
R 5	RES,MF,30.1K,+-1%,0.125W,100PPM	772061	59124	MF50DVT3012F	1	
R 6	RES,CF,51K+-5%,0.25W	747550	59124	CF1-4VT513J	1	
R 7	RES,MF,1.5M,+-1%,0.125W,100PPM	714998	59124	MF50DVT1504F	1	
R 8, 86	RES,MF,10K,+-0.1%,0.125W,50PPM	733972	59124	MF50CVT1002B	2	
R 9, 10, 16, R 33, 40, 50, R 59,115,148, R 149	RES,MF,1K,+-1%,0.125W,100PPM	816595 816595 816595 816595	59124	MF50DVT1001F	10	
R 11, 12	RES,MF,16.5K,+-1%,0.5W,100PPM	162529	91637	CMF1652F T-1	2	
R 13	RES,MF,17.4K,+-1%,0.5W,100PPM	247270	91637	CMF651742F T-1	1	
R 14, 73,137	RES,CF,43K,+-5%,0.25W	821777	59124	CF1-4VT433J	3	

Table 6-20. A16 Power Amplifier PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 15, 19, 52, R 57	RES,CC,68K,+-10%,1W	109629 109629	01121	GB6831	4	
R 17, 53	RES,MF,4.99K,+-1%,0.125W,100PPM	721548	59124	MF55D4991F	2	
R 20, 23	RES,CF,3.9K,+-5%,0.25W	810416	59124	CF1-4VT392J	2	
R 22,109,133	RES,CF,430,+-5%,0.25W	817577	59124	CF1-4VT431J	3	
R 24,138	RES,CF,200,+-5%,0.25W	810390	59124	CF1-4VT201J	2	
R 25, 32	RES,CF,750,+-5%,0.25W	810374	59124	CF1-4VT751J	2	
R 26,126,128	RES,CF,620,+-5%,0.25W	810408	59124	CF1-4VT621J	3	
R 116,129	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	2	
R 27	RES,CC,1K,+-5%,0.5W	108597	01121	EB1025	1	
R 28, 29, 34, R 47	RES,CF,1M,+-5%,0.25W	714980 714980	59124	MF50D4993F	4	
R 30	RES,CF,330,+-5%,0.25W	830596	59124	CF1-4VT331J	1	
R 31	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	1	
R 35, 74,139	RES,CF,20,+-5%,0.25W	810382	59124	CF1-4VT200J	3	
R 36,141,151, R 152	RES,CF,47,+-5%,0.25W	822189 822189	59124	CF1-4VT470J	4	
R 37	RES,CF,12K,+-5%,0.25W	757799	59124	CF1-4VT123J	1	
R 38,118	RES,CF,47K,+-5%,0.25W	721787	59124	CF1-4VT473J	2	
R 41, 51, 55	RES,CC,200K,+-5%,1W	109926	01121	GB2041	3	
R 46,108,110- R 113	RES,CF,100,+-5%,0.25W	810465 810465	59124	CF1-4VT101J	6	
R 58	RES,CF,33,+-5%,0.25W	414524	59124	CF1-4330JB	1	
R 61	RES,CF,750K,+-5%,0.25W	747543	59124	CF1-4VT754J	1	
R 84	RES,MF,22.1K,+-1%,0.125W,100PPM	655266	59124	MF50DVT2212F	1	
R 85	RES,CC,27M,+-5%,0.25W	221994	01121	CB2765	1	
R 87	RES,MF,84.5,+-1%,0.125W,100PPM	236851	91637	CMF5584R5F T-1	1	
R 88, 91, 97, R 98	RES,MF,10,+-1%,0.125W,100PPM	820399 820399	59124	MF50DVT10R0F	4	
R 92	RES JUMPER,0.02MAX	682575	89536	682575	1	
R 117	RES,CF,24K,+-5%,0.25W	697599	59124	CF1-4VT243J	1	
R 120	RES,CC,47,+-5%,0.5W	159608	01121	EB4705	1	
R 125	RES,CF,2K,+-5%,0.25W	810457	59124	CF1-4VT202J	1	
R 132	RES,MF,20K,+-0.1%,0.25W,25PPM	810564	91637	CMF552002B T-9	1	
R 142	RES,CF,200K,+-5%,0.25W	681841	59124	CF1-4VT204J	1	
R 143	RES,CF,300K,+-5%,0.25W	732818	59124	CF1-4VT304J	1	
R 144	RES,CF,1K,+-5%,0.25W	780585	59124	CF1-4VT102J	1	
R 146,147	RES,CF,2.4,+-5%,0.25W	348508	80031	5043C2002R40J	2	
R 150	RES,CF,15,+-5%,0.25W	348755	59124	CF1-4150JB	1	
TP 1- 5, 7- TP 13, 16, 17	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	91984	1SOT1	14	
TP 6	SOCKET,SINGLE,PWB,FOR 0.080 PIN	170480	74970	105-752	1	
TP 14	SOCKET,SINGLE,PWB,FOR 0.080 PIN	149138	74970	105-0757	1	
TP 15	SOCKET,SINGLE,PWB,FOR 0.080 PIN	149120	74970	105-0754	1	
U 1	⚡ IC,OP AMP,PRGRBL OUT CURRNT,8 PIN DIP	418913	27014	LM4250CN	1	
U 2, 5	⚡ IC,CMOS,QUAD BILATERAL SWITCH	910708	17856	DG444DJ	2	
U 4	⚡ IC,OP AMP,HI SPEED,LOW NOISE,8 DIP	875815	13919	OPA627AP	1	
U 7	⚡ IC,OP AMP,JFET INPUT,22V SUPPLY,DIP	832584	04713	LF356BN	1	
U 8	⚡ IC,CMOS,HEX INVERTER	381848	02735	CD4049AE	1	
U 9	⚡ IC,OP AMP,CHOPPER STABLIZED,8 PIN PKG	831263	64155	LT1052CN8	1	
U 10	⚡ IC,BPLR,FAHRENHEIT TEMPERTURE SENSOR	845156	27014	LM34CZ	1	
VR 6, 11, 19, VR 22, 26, 28, VR 32	⚡ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W ⚡ ⚡	810267 810267 810267	14552	DZ810317D	7	
VR 8, 9, 61, VR 62	⚡ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W ⚡	920423 920423	04713	1N746ARR1	4	

Table 6-20. A16 Power Amplifier PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
VR 15	ϟ ZENER,UNCOMP,18.0V,5%,7.0MA,0.4W	810325	04713	1N967BRR1	1	
VR 18	ϟ ZENER,UNCOMP,15.0V,5%,8.5MA,0.4W	820415	04713	1N965BRR1	1	
VR 51, 52, 57, VR 58	ϟ ZENER,UNCOMP,6.8V,5%,20.0MA,0.4W ϟ	820431 820431	04713	1N754ARR1	4	
VR 64	ϟ ZENER,UNCOMP,24.0V,5%,20MA,0,4W	810317	04713	1N970BRR1	1	
VR 65	ϟ ZENER,UNCOMP,8.2V,5%,20MA,0.4W	810309	65940	1N756AT-88	1	
Z 1	ϟ RES,NET,THN F. 396K,(2)+-500/5PPM	764399	89536	764399	1	
NOTES:	ϟ Static sensitive part.					

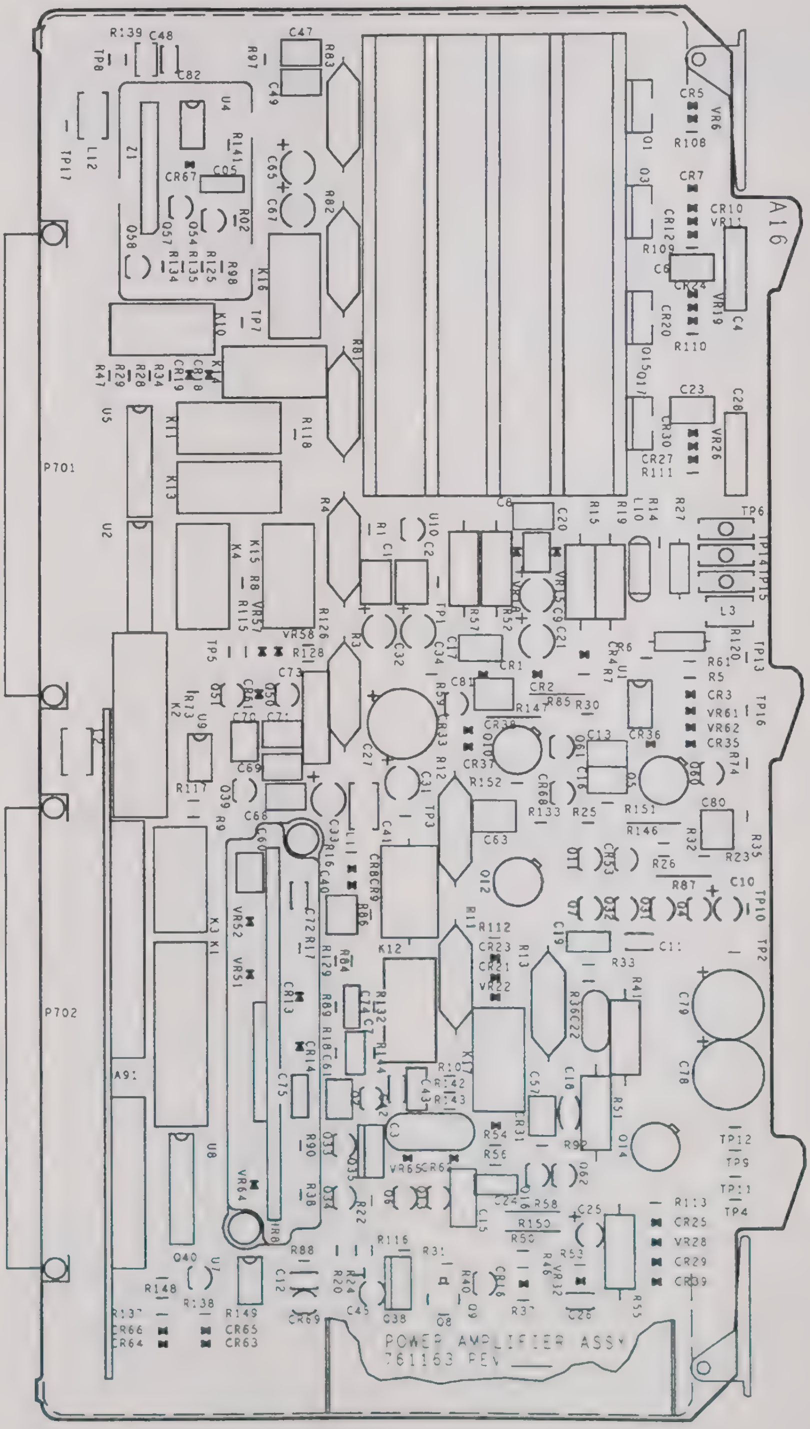


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Figure 6-20. A16 Power Amplifier PCA

Table 6-21. A16A1 Power Amplifier Digital Control SIP PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 52	CAP,AL,15UF,+-20%,35V	614024	74840	156RLR035M	1	
C 53, 56	CAP,CER,33PF,+-5%,50V,C0G	714543	04222	SR215A330JAT	2	
C 54	CAP,CER,470PF,+-10%,50V,C0G	733071	04222	SR215A471KAT	1	
C 55, 57	CAP,POLYES,0.22UF,+-5%,50V	747519	60935	185.22J0050RCB	2	
L 4	CHOKE,6TURN	320911	89536	320911	1	
MP 3	HEADER,2 ROW,.100CTR,RT ANG,10 PIN	658112	00779	1-87230-5	1	
P 1, 2	HEADER,2 ROW,.100CTR,RT ANG,26 PIN	512590	00779	1-87230-3	2	
R 101,105	RES,MF,1K,+-1%,0.125W,100PPM	816595	59124	MF50DVT1001F	2	
R 102	RES,CF,16K,+-5%,0.25W	714303	59124	CF1-4VT163J	1	
R 103	RES,CF,10K,+-5%,0.25W	697102	59124	CF1-4VT103J	1	
R 104	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	1	
R 106	RES,CF,1K,+-5%,0.25W	780585	59124	CF1/4102J	1	
U 9	ϟ IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	01295	SN74LS138N	1	
U 10, 12	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	2	
U 11	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 13, 15	ϟ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	2	
U 14	ϟ IC,CMOS,8-1 LINE MUX/DEMUX ANALOG SW	836304	04713	MM74HC4051N	1	
Z 1	RES,CERM,SIP,10 PIN,9 RES,47K,+-2%	485193	91637	CSC10A-01-473G	1	
Z 2	RES,CERM,SIP,10 PIN,9 RES,4.7K,+-2%	484063	91637	CSC10B-01-472G	1	
NOTES:	ϟ Static sensitive part.					

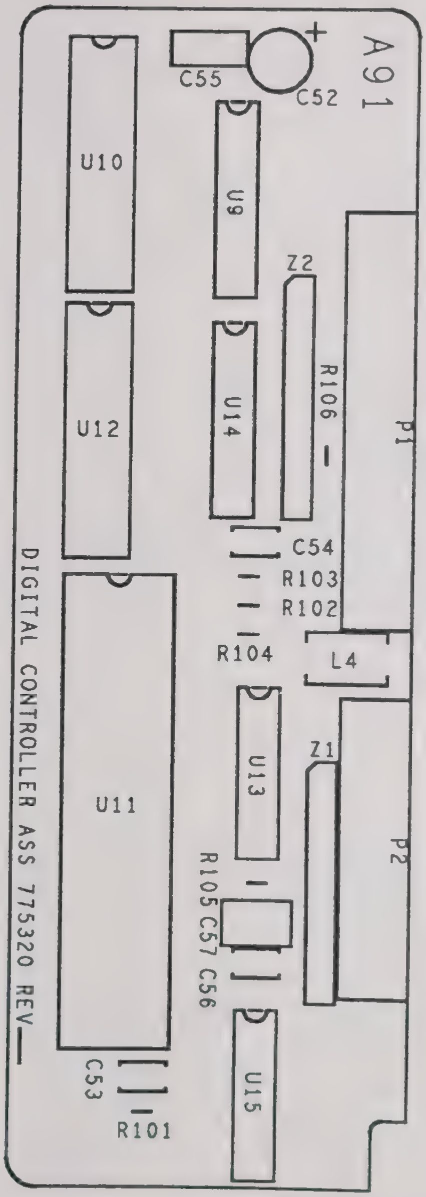

Figure 6-21. A16A1 Power Amplifier Digital Control SIP PCA

Table 6-22. A17 Regulator/Guard Crossing PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 2, 4, C 6, 7, 9, C 11, 12, 14- C 16, 19- 23, C 27, 28	CAP,AL,10UF,+-20%,50V,SOLV PROOF	799437 799437 799437 799437 799437	62643	KMC50VB10RM5X11RP	18	
C 3, 10, 18, C 25	CAP,CER,0.05UF,+-20%,100V,Z5V	149161 149161	60705	565CBA101AR503MA05	4	
C 5, 24, 29, C 102	CAP,AL,22UF,+-20%,35V,SOLV PROOF	851766 851766	62643	KRE35VB22RM6X5RP	4	
C 8, 13	CAP,TA,22UF,+-20%,25V	845149	31433	T356G226M025AS	2	
C 17, 26, 65, C 66	CAP,AL,10UF,+-20%,63V,SOLV PROOF	816843 816843	62643	KM63VB10RM5X11RP	4	
C 52, 53	CAP,CER,15PF,+-20%,50V,C0G	697524	04222	SR215A150MAT	2	
C 54, 56, 59, C 60,101,104- C 107,109,110, C 112-114	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913	60935	185-2/0.1/K0050RAB	14	
C 55, 58	CAP,TA,10UF,+-20%,10V	714766	56289	199D106X0010BA1	2	
C 57	CAP,TA,47UF,+-20%,10V	733246	56289	199D476X0010DA1	1	
C 61, 62	CAP,CER,22PF,+-5%,50V,C0G	714550	04222	SR215A220JAT	2	
C 63, 64	CAP,CER,100PF,+-2%,50V,T2J	362665	51406	RD8721N47010G50V	2	
C 67- 70	CAP,TA,22UF,+-20%,25V	357780	31433	T361B226M025AS	4	
CR 1- 34	DIODE,SI,100 PIV,1.0 AMP	742874	65940	1N4002A	34	
CR 35	ϟ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	313247	28480	5082-6264 T25	1	
CR 36	THYRISTOR,SI,SCR,VBO=200V,8.0A	634147	04713	MCR72-4	1	
F 1	FUSE,8X8.5MM,3.15A,250V,SLOW,RADIAL	832253	60046	19372-3.150	1	
H 19- 22	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
H 45- 48	SCREW,MACH,PH,P,STL,6-32,.500	320051		COMMERCIAL	4	
H 49- 52	HEAT DIS ACC,NYL,TO-3	853952	13103	8181E1	4	
H 53- 60	NUT,CAP EXT LW,STL,6-32X.109	152819	78189	511-061800-00	8	
J 801,802	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-S0D2TS	2	
L 51	CHOKE, 3 TURN	452888	89536	452888	1	
L 53, 54	CHOKE,2TURN	417196	89536	417196	2	
MP 1, 5, 13	HEAT DIS,PRESS ON,TO-5	418384	13103	2225B	3	
MP 2- 4, 9, MP 37	HEAT DIS,PWB MT,.75X.50X.50,TO-220	816587 816587	30161	5968B	5	
MP 6- 8, 11	HEAT DIS,HORIZ,1.88X1.40X1.25,TO-3	643593	13103	6016B-1.25	4	
MP 10	HEAT DIS,SNAP ON,.75,TO-5	853283	30161	5784B	1	
MP 12	HEAT DIS,CLIP,1.00,1.18,.50,TO-220	643353	13103	6038B-TT	1	
MP 14	HEAT DIS,VERT,1.00X.31X.81,TO-220	853395	98978	PSC2T-2CB	1	
MP 23	SHIELD, GUARD CROSSING	761353	89536	761353	1	
MP 24- 27	RIVET,POP,DOME,AL,.125X.316	807347	0CLN7	AD42H	4	
MP 35, 36	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 38	RIVETED,VOLTAGE REGULATOR AIR DUCT	883835	89536	883835	1	
MP 39- 42	INSUL PART,TRANS,SILICONE,TO-3	473165	55285	7403-09FR-05	4	
MP 59- 62,	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	4	
MP 71, 72	PAD, ADHESIVE	735365	89536	735365	2	
Q 1	ϟ TRANSISTOR, SI, BV=60V, 65W, TO-220	559989	04713	TIP125	1	
Q 2	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	386128	01295	TIP120T	1	
R 1, 4	RES,MF,113,+-0.1%,0.125W,100PPM	484238	91637	CMF551130B T-1	2	
R 2, 8	RES,MF,2.67K,+-1%,0.5W,100PPM	161430	91637	CMF652671F T-1	2	
R 5, 11	RES,MF,203,+-.1%,.125W,100PPM	851191	91637	CMF552030B T-1	2	
R 6	RES,MF,2.61K,+-0.1%,0.125W,100PPM	851571	91637	CMF552611B T-1	1	
R 10	RES,MF,2.67K,+-0.1%,0.125W,25PPM	340596	80031	5033RE2671F	1	
R 13	RES,CF,10,+-5%,0.25W	340075	59124	CF1-4100J5	1	
R 14, 18	RES,MF,150,+-0.1%,0.125W,100PPM	832360	91637	CMF551500B T-1	2	

Table 6-22. A17 Regulator/Guard Crossing PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 15, 17	RES,MF,5.11K,0.1%,0.5W,100PPM	832378	91637	CMF655111B T-1	2	
R 19	RES,CC,3K,+-5%,0.5W	109090	01121	EB3021	1	
R 20, 58	RES,CF,3K,+-5%,0.25W	441527	59124	CF1-4302JB	2	
R 52	RES,MF,1K,+-1%,0.125W,100PPM	168229	91637	CMF551001F T-1	1	
R 53	RES,CF,10M,+-5%,0.25W	875257	59124	CF1-4106JB	1	
R 54	RES,CF,1.8K,+-5%,0.25W	441444	65940	R25J182	1	
R 56	RES,CF,150,+-5%,0.25W	343442	59124	CF1-4151JB	1	
R 57	RES,CF,100,+-5%,0.25W	348771	59124	CF1-4101JB	1	
R 60, 61	THERMISTOR,DISC,POS,100,+-20%,25C	851303	91833	RL3510100110120PT5	2	
SW 51	SWITCH,PUSHBUTTON,SPST,MOMENTARY	782656	7Z884	SKHHAM	1	
T 51	RF TRANSFORMER 8 MHZ	813477	89536	813477	1	
TP 1, 4, 6, TP 8- 10, 12, TP 55, 58	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090 816090	91984	1SOT1	9	
U 1, 5, 10	⚡ IC,VOLT REG,HIGH VOLTAGE	723445	27014	LM317HVK	3	
U 2, 4	⚡ IC,VOLT REG,FIXED,+15 VOLTS,1.5 AMPS	413187	04713	MC7815CT	2	
U 3, 9	⚡ IC,VOLT REG,FIXED,-15 VOLTS,1.5 AMPS	413179	04713	MC7915CT	2	
U 6	⚡ IC,VOLT REG,ADJ,POS,LOW DROPOUT	851717	64155	LT1085CK	1	
U 7	⚡ IC,VOLT REG,ADJ,NEG,LOW DROPOUT	851720	64155	LT1033CK	1	
U 8, 11	⚡ IC,VOLT REG,FIXED,+5 VOLTS,1.0 A,TO-3	327981	34333	SG309K	2	
U 12	⚡ IC,VOLT REG,FIXED,-5 VOLTS,1.5 AMPS	394551	04713	MC7905CT	1	
U 13	⚡ IC,VOLT REG,ADJ,-1.2 TO 47V,TO-39	845276	27014	LM337HVH	1	
U 51	⚡ IC,CMOS,HEX INVERTER,UNBUFFERED	741199	04713	MC74HCU04N	1	
U 52	⚡ IC,CMOS,OCTL LINE DRVR W/3-ST OUT	741892	01295	SN74HCT244N	1	
U 53, 54	⚡ IC,CMOS,3-8 LINE DECODER/DEMUX	799478	04713	MC74HC137N	2	
U 55	⚡ IC,CMOS,OCTAL BUS TRANSCEIVER	722017	18324	74HCT245N	1	
U 56	⚡ IC,CMOS,8-BIT MPU,2.0MHZ,256 BYT RAM	876326	62786	HD63B03YP	1	
U 57	⚡ IC,TTL,DUAL AND DRVR W/OPEN COLLECTOR	393959	01295	SN75451BP	1	
U 58	⚡ IC,CMOS,PROG LOGIC,35NS,5700A-90780/A	875658	27014	875658	1	
U 59, 63	⚡ IC,CMOS,14 STAGE BINARY COUNTER	807701	04713	MC74HC4020N	2	
U 60	⚡ IC,VOLT SUPERVISOR,4.55V SENSE INPUT	780577	01295	TI7705ACP	1	
U 62	⚡ IC,CMOS,8K X 8 STAT RAM,120 NSEC	783332	12581	HM6264LP-12	1	
U 64	⚡ 32K X 8 PROM,PROGRAMMED 27C256	881698	89536	881698	1	
VR 1, 3	⚡ ZENER,UNCOMP,43V,5%,30MA,0.5W	851584	04713	1N5260B	2	
VR 2, 4	⚡ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W	246611	04713	1N748	2	
VR 5, 6	⚡ ZENER,UNCOMP,5.6V,5%,220.0MA,5.0W	454553	04713	1N5339B	2	
X 2	SOCKET,IC,24 PIN	812198	14329	802-0241-812	1	
Y 51	CRYSTAL,4.9152 MHZ,± 0.005%,HC-18/U	800367	SW664	NDK 049	1	
Y 52	CRYSTAL,8.00MHZ QUARTZ HC-18U	707133	89536	707133	1	
Z 1, 3	RES,CERM,SIP,8 PIN,4 RES,10K,+-2%	513309	91637	CSC08A-03-103G	2	
Z 2	RES,CERM,SIP,10 PIN,5 RES,10K,+-2%	529990	91637	CSC10A-03-101G	1	
Z 51	RES,CERM,DIP,16 PIN,15 RES,10K,+-5%	355305	91637	MDP16-03-103J	1	
Z 52	RES,CERM,SIP,8 PIN,4 RES,4.7K,+-2%	573881	91637	CSC08A-03 102G	1	
Z 53, 54	RES,CERM,SIP,10 PIN,5 RES,33,+-2%	622761	91637	CSC10A-03-330G	2	
NOTES:	⚡ Static sensitive part.					

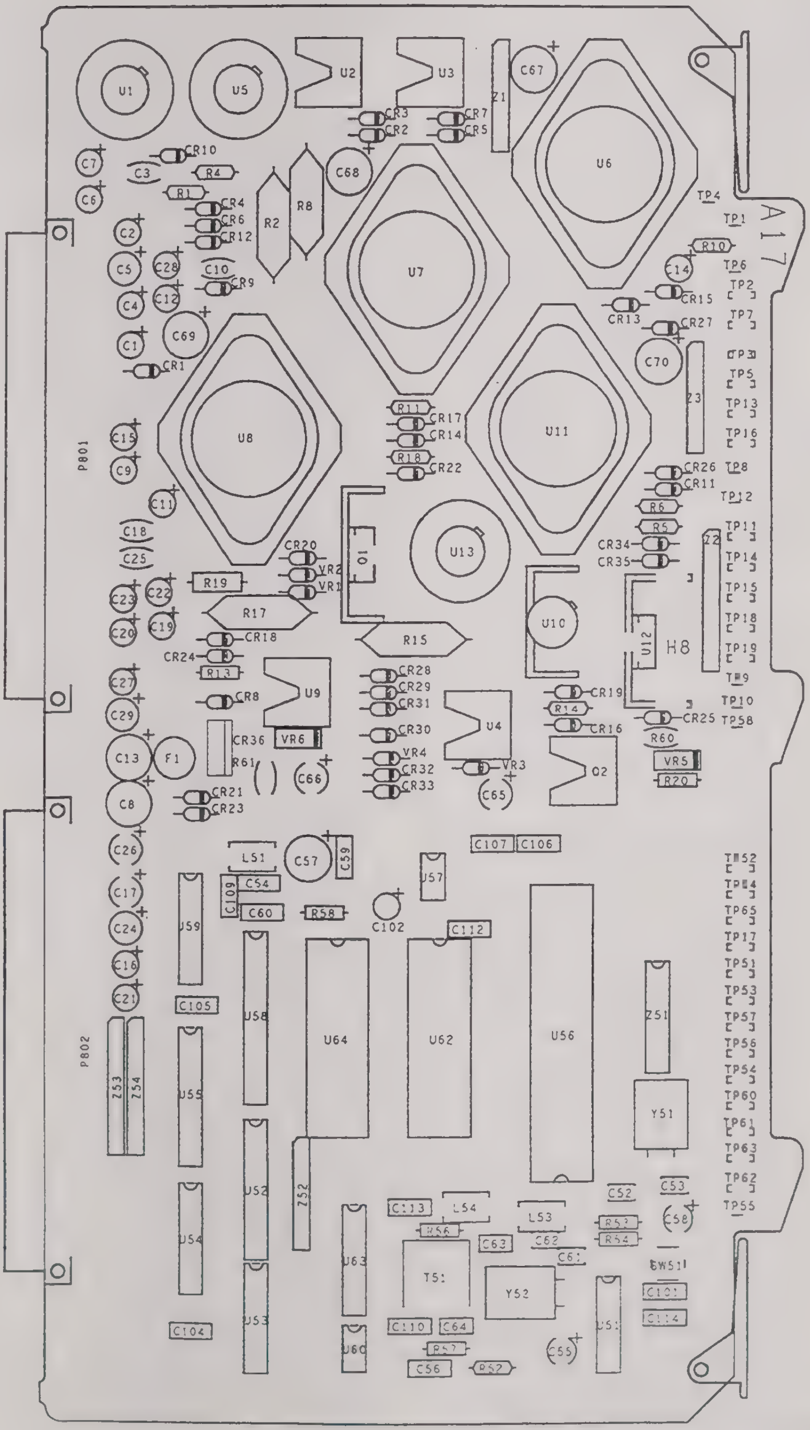

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Figure 6-22. A17 Regulator/Guard Crossing PCA

Table 6-23. A18 Filter/PA Supply PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 10, 17	CAP,POLYES,0.22UF,+-5%,50V	747519	60935	185.22J0050RCB	3	
C 2, 3	CAP,AL,6800UF,+30-20%,25V,SOLV PROOF	782466	62643	KME25VN682M30X25LLV	2	
C 4, 6	CAP,AL,1000UF,+-20%,50V,SOLV PROOF	782391	00199	CEBSM1H102M	2	
C 5, 19	CAP,AL,2200UF,+-20%,25V,SOLV PROOF	782383	62643	KME25VB222M16X25LL	2	
C 7- 9, 18	CAP,AL,330UF,+-20%,100V,SOLV PROOF	816785	62643	KME100VB331M16X25LL	4	
C 11	CAP,AL,220UF,+-20%,25V,SOLV PROOF	816793	62643	KME25VB221M8X11.5RP	1	
C 12, 22	CAP,AL,22UF,+-20%,35V,SOLV PROOF	817056	62643	KMA35VB220M6X7PT	2	
C 13- 16	CAP,AL,3300UF,+30-20%,50V,SOLV PROOF	782458	62643	KME50VN332M30X30LLV	4	
C 20	CAP,AL,10UF,+-20%,63V,SOLV PROOF	816843	62643	KME63VB10RM5X11RP	1	
C 21	CAP,AL,470UF,+-20%,50V,SOLV PROOF	747493	62643	KMC50VB471M16X25LLV	1	
C 23,209,210	CAP,POLYES,1UF,+-10%,50V	733089	60935	185/1.00K0050RGB	3	
C 201,203,204, C 206	CAP,AL,47UF,+-20%,400V,SOLV PROOF	782532 782532	62643	NM400VN47RM22X30SDV	4	
C 202,205	CAP,AL,3.3UF,+30-20%,450V,SOLV PROOF	782524	62643	SM450VB3R3M12X24LDV	2	
C 207,208	CAP,AL,100UF,+-20%,16V,SOLV PROOF	816850	62643	KME16VB101M6.3X11RP	2	
C 211,212	CAP,CER,100PF,+-5%,50V,C0G	831495	31433	C330C101J5G5CA	2	
CR 1, 2, 4, CR 5	DIODE,SI,150 PIV,5.0 AMP	523720 403055	12969	UES1303	4	
CR 3, 14	DIODE,SI,RECT,BRIDGE,BV=100V,IO=1.0A	392910	21845	F903B-21G	2	
CR 6, 7	DIODE,SI,RECT,BRIDGE,BV=200V,IO=1.0A	296509	30800	KBP 02M	2	
CR 8, 10, 12, CR 13	DIODE,SI,150 PIV,5.0 AMP	523720 816363	12969	UES1303	4	
CR 9, 16, 18	DIODE,SI,100 PIV,1.0 AMP	742874	65940	1N4002A	3	
CR 11, 15, 17	DIODE,SI,RECT,BRIDGE,BV= 50V,IO=3.0A	586115	30800	KBL005	3	
CR 19	⚡ THYRISTOR,SI,TRIAC,VBO=200V,8.0A	413013	02735	T2800B	1	
CR 201,203,208, CR 210,234,235, CR 239,243	DIODE,SI,400 PIV,1 AMP	831586 831586 831586	65940	1N4004A	8	
CR 205,217,218, CR 220,221,223, CR 224,227,228, CR 240,247,248	DIODE,SI,1K PIV,1.0 AMP	707075 707075 707075 707075	04713	1N4007-SR4348RL	12	
CR 209,236	⚡ DIODE,SI,N-JFET,CURRENT REG,IF=1.0 MA	334839	17856	J9013	2	
CR 222	DIODE,SI,RECT,BRIDGE,BV=800V,IO=1.0A	341016	30800	KBP 08M	1	
CR 244,251-253	⚡ DIODE,SI,BV= 75.0V,RADIAL INSERTED	659516	03508	1N4448	4	
F 1, 2, 8	FUSE,8X8.5MM,1.6A,250V,SLOW,RADIAL	816488	60046	19372-1.600	3	
F 3- 5, 7, F 9	FUSE,8X8.5MM,0.5A,250V,SLOW,RADIAL	831990 831990	60046	19372-0.500	5	
F 6,201-204	FUSE,8X8.5MM,0.2A,250V,SLOW,RADIAL	851949	60046	19372-0.200	5	
H 6- 9	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
J 201,202	JUMPER,REC,2 POS,.100CTR,.025 SQ POST	757294	00779	850108-1	2	
K 201	RELAY,ARMATURE,2 FORM C,5V	733063	61529	DS2E-S-DC5V	1	
MP 2	FOOT,ADHESIVE,RUBBER,BLACK,.50X.12	543488	28213	SJ5008	1	
MP 3	HEAT DIS,PRESS ON,TO-5	418384	13103	2225B	1	
MP 4, 5	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 10	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	1	
MP 201,202	HEADER,1 ROW,.100CTR,2 PIN	643916	22526	65500-102	2	
MP 203-206	HEAT DIS,VERT,1.00X1.50X.375,TO-220	816546	13103	7019B-MT	4	
MP 207-210	INSUL PART,TRANS,SILICONE,POWER	534453	55285	7403-09FR-54	4	
MP 211-214	WASHER,SHOULDER,TEFLON,#4	844824	86928	5608-72	4	
MP 215-218	SCREW,MACH,PH,P,STL,4-40X0.250	129890		COMMERCIAL	4	
MP 219-222	NUT,MACH,HEX,STL,4-40	110635		COMMERCIAL	5	
P 901,902	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	7264-5002TB	2	
Q 201,202	⚡ TRANSISTOR,SI,N-MOS,30W,500V,TO-220	782540	04713	MTP2N50	2	
Q 203,206	⚡ TRANSISTOR,SI,PNP,SM SIG,SELECTED HFE	650846	04713	SPS8822RLRA2	2	

Table 6-23. A18 Filter/PA Supply PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
Q 204,209,210, Q 212	⚡ TRANSISTOR,SI,P-MOS,500V,TO-92 ⚡	782508 782508	59640	VP0550N3	4	
Q 205,207,208, Q 213	⚡ TRANSISTOR,SI,N-DMOS,500V,TO-92 ⚡	782490 782490	17856	V11949TR	4	
Q 211,214	⚡ TRANSISTOR,SI,NPN,350V,0.625W,TO-92	853994	04713	2N6517	2	
Q 215,216	⚡ TRANSISTOR,SI,P-MOS,POWER,500VT0220AB	782482	04713	MTP2P50	2	
Q 217	⚡ TRANSISTOR, SI, 100V, 1W, CASE 152-02	806497	04713	MPSU07	1	
Q 218	⚡ TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	04713	2N3904RLRA2	1	
Q 219	⚡ TRANSISTOR,SI,PNP,T092	698233	04713	2N3906RLRA	1	
R 1	RES,CC,560,+-5%,1W	266361	01121	GB5615	1	
R 2- 5	RES,CC,20K,+-5%,0.5W	109041	01121	EB2031	4	
R 201,244	RES,CF,8.2,+-5%,0.25W	442269	59124	CF1-48R2JB	2	
R 202,243	RES,CF,5.1,+-5%,0.25W	640995	59124	CF1-45R1J	2	
R 203,241,256, R 257	RES,CF,9.1K,+-5%,0.25W	706663 706663	59124	CF1-4VT912J	4	
R 204,253	RES,CF,1.5,+-5%,0.25W	732800	59124	CF1-4VT1R5J	2	
R 205,216,229, R 240	RES,CC,560K,+-10%,0.5W	108795 108795	01121	EB5641	4	
R 206,239	RES,CF,1M,+-5%,0.25W	649970	59124	CF1-4VT105J	2	
R 207,209,237, R 238	RES,CF,470K,+-10%,0.5W	108290 108290	01121	EB4741	4	
R 208,210,235, R 236	RES,CC,220K,+-10%,1W	109652 109652	01121	GB2241	4	
R 211	RES,CF,47,+-5%,0.25W	822189	59124	CF1-4VT470J	1	
R 212,220,222, R 231,242	RES,CF,33K,+-5%,0.25W	733667 733667	59124	CF1-4VT333J	5	
R 213,217,218, R 230,232,245, R 249	RES,CF,10K,+-5%,0.25W	697102 697102 697102	59124	CF1-4VT103J	7	
R 214,233	RES,CF,200K,+-5%,0.25W	681841	59124	CF1-4VT204J	2	
R 215,234	RES,CC,330,+-10%,0.5W	108589	01121	EB3311	2	
R 221,250	RES,CF,82K,+-5%,0.25W	655027	59124	CF1-4VT823J	2	
R 225	RES,CF,100K,+-5%,0.25W	573584	59124	CF1-4104JB	1	
R 226,248	RES,MF,3.16K,+-1%,0.125W,100PPM	235291	91637	CMF-553161F T-1	2	
R 228,247	RES,CF,100K,+-5%,0.25W	658963	59124	CF1-4VT104J	2	
R 246,251	RES,CF,4.7K,+-5%,0.25W	721571	59124	CF1-4VT472J	2	
R 252	RES,CF,300K,+-5%,0.25W	732818	59124	CF1-4VT304J	1	
R 254,255	RES,CC,27,+-5%,0.5W	260984	01121	EB2705	2	
RT 1, 2	THERMISTOR,DISC,POSITIVE,50,+-30%	816140	54583	911X22E500NRO7A	2	
S 201	SWITCH,SLIDE,DPDT	436691	79727	GF-126	1	
TP 1- 22,203, TP 205-212	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	91984	1SOT1	31	
TP 201	SOCKET,SINGLE,PWB,FOR 0.080 PIN	170480	74970	105-752	1	
TP 204	SOCKET,SINGLE,PWB,FOR 0.080 PIN	149120	74970	105-0754	1	
U 1	⚡ IC, VOLT REG,FIXED,-5 VOLTS,0.1 AMPS	816322	04713	MC79L05ACG	1	
U 2	⚡ IC,VOLT REG,FIXED,+5 VOLTS,0.1 AMPS	816355	04713	MC78L05ACG	1	
U 3	⚡ IC,VOLT REG,FIXED,-18 VOLTS,1.5AMPS	845474	04713	MC7918CT	1	
U 201	⚡ IC,COMPARATOR,QUAD,14 PIN DIP	387233	27014	LM339N	1	
VR 20, 21	⚡ ZENER,UNCOMP,82.0V,5%,1.5MA,0.5W	844977	04713	1N5268B	2	
VR 202,213,233, VR 242	⚡ ZENER,UNCOMP,10.0V,5%,12.5MA,0.4W ⚡	810267 810267	04713	IN961BRR1	4	
VR 206,207,218, VR 228,237,238	⚡ ZENER,UNCOMP,10.0V,5%,20.0MA,0.5W ⚡	820480 820480	04713	1N5240BRR1	6	
VR 211,217,227, VR 231	⚡ ZENER,UNCOMP,140.0V,5%,1.8MA,1.0W ⚡	340703 340703	12969	UZ8114	4	
VR 212,216,226, VR 232	⚡ ZENER,UNCOMP,180V,2%,0.68MA,0.4W ⚡	816348 816348	04713	1N5279CTA2	4	

Table 6-23. A18 Filter/PA Supply PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
VR 214,230,246, VR 247	ϟ ZENER,UNCOMP,56.0V,5%,2.2MA,0.4W ϟ	832568 832568	04713	1N979BRR1	4	
VR 215,219,225, VR 229	ϟ ZENER,UNCOMP,200.0V,5%,5.0MA,5.0W ϟ	386839 386839	04713	1N5388B	4	
VR 245	ϟ ZENER,UNCOMP,3.3V,5%,20.0MA,0.4W	820423	04713	1N746ARR1	1	
Z 1- 3	RES,CERM,SIP,10 PIN,5 RES,10K,+-2%	529990	91637	CSC10A-03-103G	3	
Z 201	RES,CERM,SIP,6 PIN,5 RES,100K,+-2%	412726	91637	CSC06A-03-104G	1	
NOTES:	ϟ Static sensitive part.					

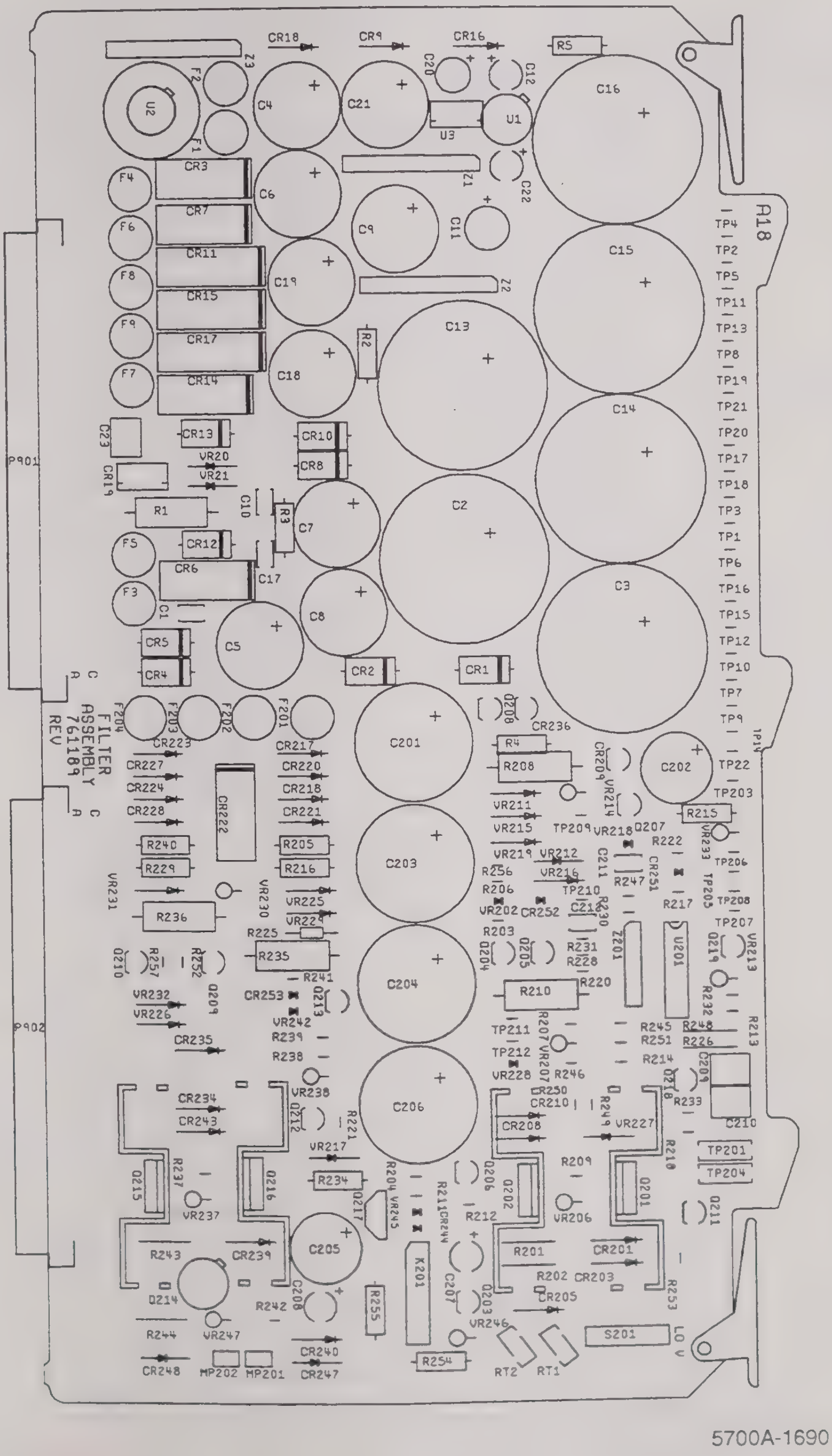


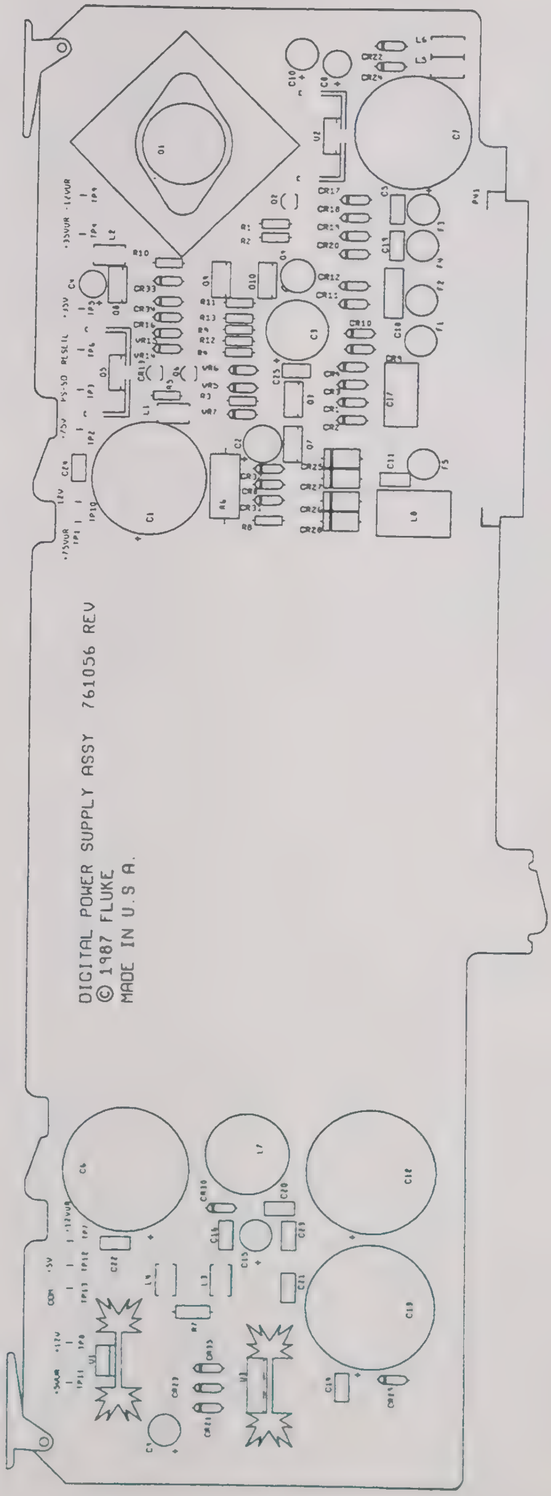
Figure 6-23. A18 Filter/PA Supply PCA

Table 6-24. A19 Digital Power Supply PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1	CAP,AL,470UF,+-20%,160V,SOLV PROOF	816835	62643	KME160VN471M30X30LLV	1	
C 2	CAP,AL,10UF,+-20%,160V,SOLV PROOF	817064	62643	KME160VB10RM10X16LL	1	
C 3	CAP,AL,330UF,+-20%,100V,SOLV PROOF	816785	62643	KME100VB331M16X25LL	1	
C 4, 9	CAP,AL,10UF,+-20%,63V,SOLV PROOF	816843	62643	KM63VB10RM5X11RP	2	
C 5, 11	CAP,CER,0.10UF,+-20%,50V,X7R	853650	04222	SR215C104MAATR	2	
C 6	CAP,AL,10000UF,+-20%,25V,SOLV PROOF	816819	62643	SME25VN103M30X0LLV	1	
C 7	CAP,AL,6800UF,+30-20%,25V,SOLV PROOF	782466	62643	KME25VN682M30X25LLV	1	
C 8	CAP,AL,2.2UF,+-20%,50V,SOLV PROOF	816868	62643	KME50VB2R2M5X11RP	1	
C 10	CAP,AL,22UF,+-20%,35V,SOLV PROOF	817056	62643	KMA35VB220M6X7PT	1	
C 12, 13	CAP,AL,22000UF,+-20%,16V,SOLV PROOF	822379	62643	SME16VN223M35X30LLV	2	
C 14, 16, 19- C 23	CAP,CER,0.22UF,+-20%,50V,X7R	853648 853648	04222	SR325C224MAATRA	7	
C 15	CAP,AL,100UF,+-20%,16V,SOLV PROOF	816850	62643	KME16VB101M6.3X11RP	1	
C 17	CAP,POLYPR,0.047UF,+-10%,630V	500827	60935	171/.047/K/630/H	1	
C 18	CAP,POLYPR,0.047UF,+-10%,160V	446773	60935	171/.047/K/160/B-C	1	
C 24, 25	CAP,CER,0.022UF,+80-20%,500V,Z5U	740340	51406	RPE113-901Z5U223Z9	2	
CR 1- 4, 9- CR 12	DIODE,SI,200 PIV,1.0 AMP	586644 586644	04713	1N4935	8	
CR 8, 16, 21- CR 24, 29- 34	DIODE,SI,100 PIV,1.0 AMP	742874 742874	65940	1N4002A	12	
CR 13	ϟ DIODE,N-JFET,CURRENT REG,IF=3.0 MA	852137	17856	J9009-TR3	1	
CR 17- 20	DIODE,SI,50 PIV,1.0 AMP	379412	04713	1N4933	4	
CR 25- 28	DIODE,SI,50 PIV,3.0 AMP	403055	04713	MR850	4	
CR 35	ϟ DIODE,GER,BV=66 V,IO=50MA	180505	66891	1N276	1	
F 1	FUSE,8X8.5MM,0.315A,250V,SLOW,RADIAL	832337	60046	19372-0.315	1	
F 2	FUSE,8X8.5MM,0.125A,250V,SLOW,RADIAL	832261	60046	19372-0.125	1	
F 3, 4	FUSE,8X8.5MM,2A,250V,SLOW,RADIAL	806331	60046	19372-2.000	2	
F 5	FUSE,8X8.5MM,3.15A,250V,SLOW,RADIAL	832253	60046	19372-3.150	1	
H 2	SCREW,MACH,PH,P,STL,4-40X0.375	152124		COMMERCIAL	1	
H 3, 4	HEAT DIS,CLIP,1.00,1.18,.50,TO-220	643353	13103	6038B-TT	2	
H 5	HEAT DIS,VERT FINS,TO-3	342675	13103	6003-B-2	1	
H 6, 7	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	2	
H 11	SCREW,MACH,PH,P,SS,4-40X.437	403782		COMMERCIAL	1	
L 1- 6	CHOKE,6TURN	320911	89536	320911	6	
L 7	INDUCTOR, 33 UH	813485	89536	813485	1	
L 8	TRANSFORMER, PULSE	660589	89536	660589	1	
M 1, 2	FOOT,ADHESIVE,RUBBER,GREY,.44X.20	358341	28213	SJ-5003	2	
MP 8, 27	NUT,MACH,HEX,STL,4-40	110635		COMMERCIAL	2	
MP 9, 10	NUT,CAP EXT LW,STL,6-32X.109	152819	78189	511-061800-00	2	
MP 11, 12	GROMMET,SLOT,RUBBER,.250,.437	853291	73734	113006	2	
MP 13, 14	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 15, 26	HEAT DIS,VERT,1.00X1.375X0.50,TO-220	831099	13103	6098B-P2	2	
MP 16	HEAT,DIS,ACC,NYL,TO-3	851907	13103	8182-E1	1	
MP 21	INSUL PART,TRANS,SILICONE,POWER	534453	55285	7403-09FR-54	1	
MP 24	INSUL PART,TRANS,SILICONE,TO-3	473165	55285	7403-09FR-05	1	
MP 25	SPACER,TRANSISTOR MOUNT,DAP,TO-5	152207	07047	10123-DAP	1	
MP 28, 29	SCREW,MACH,PH,P,STL,6-32X0.250	152140		COMMERCIAL	2	
MP 30, 31	SPACER,SWAGED,RND,BR,6-32,.125	435578	06540	9531B-B-0632	2	
P 41	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	29213	7264-50D2TB	1	
Q 1	ϟ TRANSISTOR,SI,BV=200V,80W,TO-3	261347	04713	MJ410	1	
Q 2, 6	ϟ TRANSISTOR,SI,NPN,HI-VOLTAGE	370684	04713	MPSA42	2	
Q 3, 7- 10	ϟ TRANSISTOR,SI,BV=300V, 10W,TO-202	381731	04713	MPS-U10	5	
Q 4	ϟ TRANSISTOR,SI,VB=200V,10W,TO-5	226894	04713	2N5415	1	
Q 5	ϟ TRANSISTOR,SI,BV= 60V, 65W,TO-220	[illegible]	01295	TIP120	1	

Table 6-24. A19 Digital Power Supply PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
R 1	RES,CF,5.1,+-5%,0.25W	640995	59124	CF1-45R1J	1	
R 2	RES,CF,2K,+-5%,0.25W	573238	59124	CF1-4202JB	1	
R 3, 12	RES,CF,100K,+-5%,0.25W	573584	59124	CF1-4104JB	2	
R 4	RES,CC,4.7K,+-5%,0.25W	148072	01121	CB4725	1	
R 5	RES,CF,12,+-5%,0.25W	442178	59124	CF1-4120JB	1	
R 6	RES,CC,10K,+-10%,2W	110106	01121	GB1031	1	
R 7	RES,CC,2,+-5%,0.5W	218735	01121	EB2005	1	
R 8	RES,CF,120K,+-5%,0.25W	573592	59124	CF1-4121JB	1	
R 9, 11	RES,CF,33K,+-5%,0.25W	573485	59124	CF1-4333JB	2	
R 10	RES,CF,51K,+-5%,0.25W	573535	59124	CF1-4513JB	1	
R 13	RES,CC,10K,+-5%,0.25W	148106	01121	CB1035	1	
TP 1- 5, 8, TP 10, 12, 13	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	91984	150T1	9	
U 1	⚡ IC,VOLT REG,FIXED,+12 VOLTS,1.5 AMPS	413195	04713	MC7812CT	1	
U 2	⚡ IC,VOLT REG,FIXED,-12 VOLTS,1.5 AMPS	381665	04713	MC7912CT	1	
U 3	⚡ IC,VOLT REG,FIXED,5 VOLTS,2 AMPS	816918	S3385	SI-3052V	1	
VR 5	⚡ ZENER,UNCOMP,6.2V,5%,20.0MA,0.4W	698662	04713	1N753A-SR4348RL	1	
VR 6	⚡ ZENER,UNCOMP,36.0V,5%,3.4MA,0.4W	186163	04713	1N974B	1	
VR 7	⚡ ZENER,UNCOMP,39.0V,5%,3.2MA,0.4W	831248	04713	1N975BTA2	1	
VR 14, 15	⚡ ZENER,UNCOMP,18.0V,5%,7.0MA,0.4W	327973	14552	1N967B	2	
NOTES:	⚡ Static sensitive part.					



5700A-1604

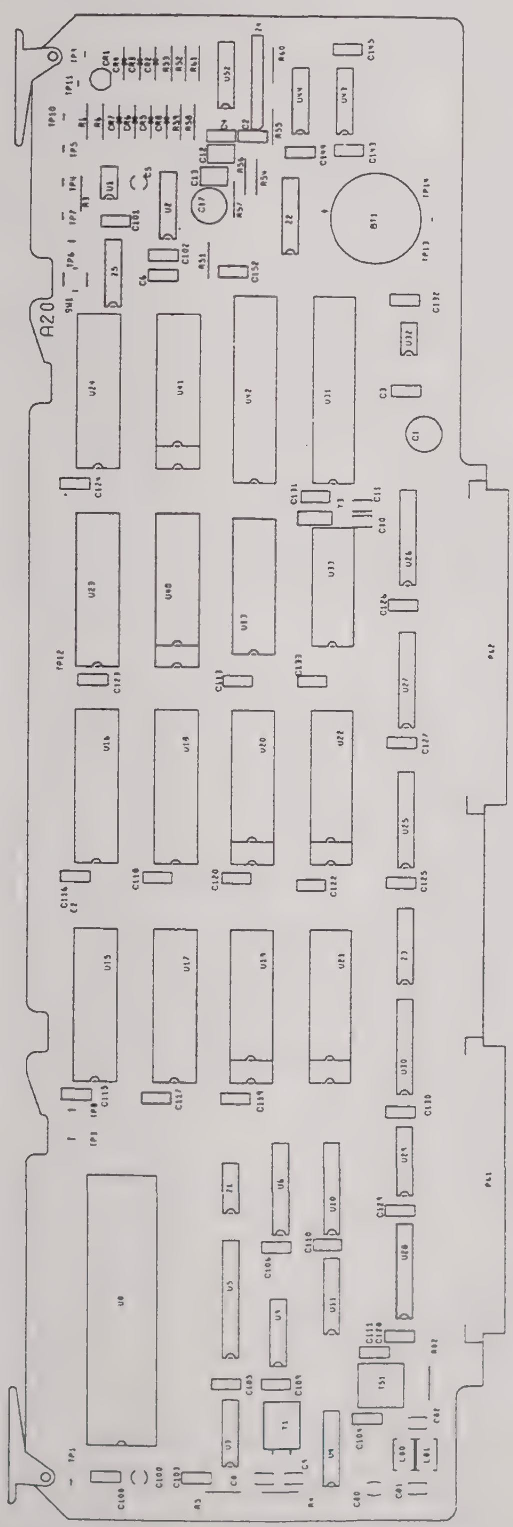
Figure 6-24. A19 Digital Power Supply PCA

Table 6-25. A20 CPU PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
BT 1	BATTERY,LITHIUM,3.0V,0.500AH	821439	67237	ES1045-01	1	
C 1	CAP,TA,220UF,+-20%,10V	474288	56289	199D227X0003EA3	1	
C 2- 4, 6, C 101-106,108- C 111,113,115- C 120,122-133, C 143-145,152	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913 649913	60935	185-2/0.1K0050RAB	37	
C 5	CAP,TA,15UF,+-20%,20V	807610	56289	199D156X0020DA1	1	
C 8- 11	CAP,CER,22PF,+-2%,50V,C0G	714832	04222	SR215A220GAT	4	
C 12, 13	CAP,POLYES,0.22UF,+-10%,50V	706028	60935	185-2/.22K0050RCB	2	
C 17	CAP,AL,47UF,+-20%,35V,SOLV PROOF	643312	62643	LR35VB470M10X15LLV	1	
C 80	CAP,CER,0.22UF,+80-20%,50V,Z5U	649939	04222	SR215E224MAA	1	
C 81, 82	CAP,CER,120PF,+-5%,50V,C0G	721142	04222	SR215A121JAT	2	
C 100	CAP,TA,2.2UF,+-20%,16V	706804	56289	199D225X0016AA1	1	
CR 1	LED, RED, T1-3/4,5MM LEAD SPACING	723486	25088	LDH1111-329	1	
CR 2, 3, 7	DIODE,SI,100 PIV,1.0 AMP	742874	65940	1N4002A	3	
CR 4- 6, 8	ϟ DIODE,SI,SCHOTTKY BARRIER,SMALL SIGNL	313247	28480	5082-6264 T25	4	
H 3- 6	RIVET,S-TUB,OVAL,STL,.087,.343	838458		COMMERCIAL	4	
L 80, 81	CHOKE, 3 TURN	452888	89536	452888	2	
M 3, 4	FOOT,ADHESIVE,RUBBER,GREY,.44X.20	358341	28213	SJ-5003	2	
MP 1, 2	EJECTOR,PWB,NYLON	494724	32559	CP-66	2	
MP 7, 8	PAD, ADHESIVE	735365	89536	735365	1	
P 61, 62	CONN,DIN41612,TYPE C,RT ANG,64 PIN	807800	28213	726450D2TB	2	
R 1, 3	RES,CF,470,+-5%,0.25W	573121	59124	CF1-4471JB	2	
R 4	RES,CF,10M,+-5%,0.25W	696971	59124	CF1-4106JB	1	
R 5	RES,CF,1.8K,+-5%,0.25W	573220	59124	CF1-4182JB	1	
R 6	RES,CF,6.2K,+-5%,0.25W	573345	59124	CF1-4622JB	1	
R 51- 54	RES,MF,5.11K,+-1%,0.125W,100PPM	720342	91637	CMF-555111F T-1	4	
R 55	RES,MF,10K,+-1%,0.125W,100PPM	719476	91637	CMF-551002F T-1	1	
R 56, 57	RES,MF,1K,+-1%,0.125W,100PPM	719468	91637	CMF-551001F T-1	2	
R 58, 59	RES,MF,39.2K,+-1%,0.125W,25PPM	312207	91637	CMF-553922F T-9	2	
R 60, 61	RES,MF,1M,+-1%,0.125W,100PPM	719492	91637	CMF-551004F T-1	2	
R 81, 82	RES,CF,150,+-5%,0.25W	573030	59124	CF1-4151JB	2	
SW 1	SWITCH,PUSHBUTTON,SPST,MOMENTARY	782656	72884	SKHHAM	1	
T 51	RF TRANSFORMER 8 MHZ	813477	89536	813477	1	
TP 1, 3- 12	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	11	
U 1	ϟ IC,VOLT SUPERVISOR,4.55V SENSE INPUT	780577	01295	TI7705ACP	1	
U 2	ϟ IC,LSTTL,HEX INVERTER W/OPEN COLLECT	394536	04713	SN74LS05N	1	
U 3	ϟ IC,CMOS,HEX INVERTER,UNBUFFERED	741199	04713	MC74HCU04N	1	
U 4, 11	ϟ IC,CMOS,14 STAGE BINARY COUNTER	807701	04713	MC74HC4020N	2	
U 5	ϟ IC,CMOS,PROG LOG,35NS,5700A-90760	845271	89536	845271	1	
U 6	ϟ IC,CMOS,PROG LOGIC,25NS,5700A-90761	845250	89536	845250	1	
U 8	ϟ IC,CMOS,16 BIT MPU,8 MHZ,DIP	816926	04713	MC68HC000P-8	1	
U 9	ϟ IC,CMOS,QUAD 2 INPUT OR GATE	817312	04713	MC74HC32N	1	
U 10	ϟ IC,CMOS,PROG LOGIC,35NS,5700A-90762	845268	89536	845268	1	
U 13	ϟ IC, NMOS, 32K X 8 EEPROM, 250NS	875260	33297	UPD28C256C-25	1	
U 15	ϟ EPROM, PROGRAMMED 27010, A20U015	761262	89536	761262	1	
U 16	ϟ EPROM, PROGRAMMED 27010, A20U016	761361	89536	761361	1	
U 17	ϟ EPROM, PROGRAMMED 27010,A20U017	761379	89536	761379	1	
U 18	ϟ EPROM, PROGRAMMED 27010, A20U018	775247	89536	775247	1	
U 19- 22	ϟ IC,CMOS,32K X 8 STATIC RAM,120 NSEC	800250	33297	D43256C12L	4	
U 25, 27- 29	ϟ IC,CMOS,OCTL LINE DRVR W/3-ST OUT	741892	01295	SN74HCT244N	4	
U 26, 30	ϟ IC,CMOS,OCTAL BUS TRANSCEIVER	722017	18324	74HCT245N	2	
U 31	ϟ IC,CMOS,DUAL CHANNEL UART (DUART)	799494	66419	XLS68C1C	1	

Table 6-25. A20 CPU PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 32	ϟ IC,TTL,DUAL AND DRVR W/OPEN COLLECTOR	393959	01295	SN75451BP	1	
U 33	ϟ IC,CMOS,CLOCK CALENDAR	807693	34371	ITS9263	1	
U 52	ϟ IC,OP AMP,QUAD,14 PIN DIP	402669	27014	LM324N	1	
X 5, 6, 10	SOCKET,IC,24 PIN	812198	00779	2-641932-3	3	
X 8	SOCKET,IC,64 PIN	483842	00779	643575-3	1	
X 13	SOCKET,IC,28 PIN	448217	91506	228-AG39D	1	
X 15- 22	SOCKET,IC,32 PIN	807156	00779	2-644018-3	8	
Y 1	CRYSTAL,7.3728MHZ,+-1,%,HC-18U	742049	5W664	NDK 073	1	
Y 3	CRYSTAL,32.768KHZ,+-5PPM	811943	61429	FOX-032	1	
Z 1	RES,CERM,DIP,16 PIN,15 RES,3.3K,+-5%	837666	91637	MDP16-01-332J	1	
Z 2, 3	RES,CERM,DIP,16 PIN,15 RES,4.7K,+-5%	416834	91637	MDP16-01-472J	2	
Z 4	RES,CERM,SIP,10 PIN,5 RES,10K,+-2%	529990	91637	CSC10A-03-101G	1	
Z 5	RES,CERM,DIP,14 PIN,13 RES,100K,+-5%	404624	91637	MDP14-01-104J	1	
NOTES:	ϟ Static sensitive part.					



5700A-1606

Figure 6-25. A20 CPU PCA

Table 6-26. A21 Rear Panel PCA

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
C 1, 3, 5	CAP,CER,330PF,+-5%,50V,C0G	697441	04222	SR215A331JAT	3	
C 4, 21, 22, C 24- 32, 34, C 36, 37, 40- C 45, 48, 49	CAP,POLYES,0.1UF,+-10%,50V	649913 649913 649913 649913	60935	185-2/0.1K0050RAB	23	
C 6, 7	CAP,CER,0.22UF,+80-20%,50V,Z5U	649939	04222	SR215E224MAA	2	
C 8	CAP,CER,4700PF,+-20%,100V,X7R	362871	04222	SR201C472MAT	1	
C 9	CAP,CER,470PF,+-10%,50V,C0G	733071	04222	SR215A471KAT	1	
C 10, 70	CAP,TA,68UF,+-20%,15V	193615	56289	196D686X0015LA3	2	
C 11- 15	CAP,TA,10UF,+-20%,25V	714774	56289	199D106X0025CA1	5	
C 16	CAP,TA,10UF,+-20%,35V	816512	56289	199D106X0035EA1	1	
C 33	CAP,TA,39UF,+-20%,20V	358234	56289	199D396X0020EA1	1	
C 46, 50	CAP,TA,1UF,+-20%,35V	697417	56289	199D105X0035AA1	2	
C 47	CAP,CER,33PF,+-2%,50V,C0G	715292	04222	SR215A330GAT	1	
CR 1- 4	ϟ DIODE,SI,BV= 75.0V,IO=150MA,500MW	698720	65940	1N4448	4	
F 1, 2	FUSE,.095 X .28,0.25A,FAST,AXIAL	806737	75915	R255.250-T	2	
J 1	CONN,MICRO-RIBBON,REC,PWB,24 POS	851675	02660	57-20240-23	1	
J 2	CONN,D-SUB,PWB,25 PIN	845214	28198	HDC25M30000-14	1	
J 3	CONN,D-SUB,PWB,15 SCKT	837336	28198	HDC15F30000	1	
J 4	CONN,D-SUB,PWB,15 PIN	837328	28198	HDC15M30000	1	
J 5, 6	CONN,COAX,BNC(F),PWB	479162	24931	28JR175	2	
J 7	CONN,D-SUB,PWB,4 CAVITY,32 SCKT	810846	02660	117-DDM-36W4SU	1	
J 8	HEADER,2 ROW,.100CTR,40 PIN	807453	59730	501-4027ES	1	
J 9	HEADER,2 ROW,.100CTR,34 PIN	807446	59730	500-3427ES	1	
J 11, 12	HEADER,1 ROW,.100CTR,3 PIN	837351	00779	103638-2	2	
K 1, 4, 5, K 7- 12	RELAY,ARMATURE,2 FORM C,5V	733063 733063	33297	MR602-5SR	9	
K 2, 3, 6	RELAY,ARMATURE,4 FORM C,5V,LATCH	715078	61529	DS4EML2DC5VCH239	3	
L 1	CHOKE,6TURN	320911	89536	320911	1	
MP 1, 2	SPACER,SWAGED,RND,BR,6-32,.220	261727	06540	9533B-B-0632	2	
MP 3- 10	SPACER,SWAGED,RND,BR,4-40,.234	385310	06540	9533B-B-0440	8	
MP 21, 22	SPACER,SWAGED,RND,BR,6-32,.437	423806	06540	9536B-B-0632	2	
Q 1, 2	ϟ TRANSISTOR,SI,N-CHAN,TO-92,SWITCH	832139	17856	J2903	2	
R 1	RES,MF,1K,+-1%,0.125W,100PPM	719468	91637	CMF-551001F T-1	1	
R 2	RES,MF,332,+-1%,0.125W,100PPM	192898	91637	CMF-553320F T-1	1	
R 3	RES,CF,5.1K,+-5%,0.25W	573329	59124	CF1-4512JB	1	
R 4, 5, 12, R 13, 16, 17	RES,CF,10K,+-5%,0.25W	573394 573394	59124	CF1-4103JB	6	
R 6	RES,CF,15K,+-5%,0.25W	573428	59124	CF1-4153JB	1	
R 7, 14	RES,CF,1K,+-5%,0.25W	573170	59124	CF1-4102JB	2	
R 8, 9	RES,CF,200,+-5%,0.25W	573055	59124	CF1-4201JB	2	
R 10	RES,CF,620,+-5%,0.25W	641092	59124	CF1-4621JB	1	
R 11	RES,CC,1K,+-10%,1W	109371	01121	GB1021	1	
R 20	RES,CF,200K,+-5%,0.25W	573634	59124	CF1-4204JB	1	
S 1	SWITCH,SLIDE,SPDT,LOW PROFILE	911250	72884	SSSS91 (G7857294M)	1	
TP 1- 15	JUMPER,WIRE,NONINSUL,0.200CTR	816090	91984	150T1	15	
U 1	ϟ IC,CMOS,OCTAL BUS TRANSCEIVER	722017	18324	74HCT245N	1	
U 2	ϟ IC,NMOS,GPIB ADAPTER	585240	01295	TMS9914ANL	1	
U 3	ϟ IC,LSTTL,OCTAL GPIB XCVR W/OPEN COL	585224	01295	SN75160BN	1	
U 4	ϟ IC,LSTTL,OCTAL IEEE-488 BUS TRANSCVR	686022	01295	SN75162BN	1	
U 5	ϟ IC,CMOS,DUAL CHANNEL UART (DUART)	799494	66419	XLS68C1C	1	
U 6	ϟ IC,TTL,QUAD RS232C LINE DRIVER	414052	04713	MC1488P	1	
U 7	ϟ IC,TTL,QUAD RS232C LINE RECEIVER	524660	04713	MC1489AN	1	
U 8	ϟ IC,CMOS,PROG LOGIC,35NS,5700A-9079	845255	89536	845255	1	

Table 6-26. A21 Rear Panel PCA (cont)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	NOTES
U 9, 10	ϟ IC,CMOS,OCTL D F/F W/3-STATE,+EDG TRG	585364	04713	MC74HCT374N	2	
U 11, 12	ϟ IC,CMOS,OCTL LINE DRVR W/3-ST OUT	741892	01295	SN74HCT244N	2	
U 13	ϟ IC,OP AMP,JFET INPUT,22V SUPPLY,DIP	832584	04713	LF356BN	1	
U 14	ϟ IC,CMOS,PROGRMBL PERIPHERAL INTERFACE	780650	34371	CP82C55A	1	
U 16, 17	ϟ IC,BIMOS,8 CHNL HI-VOLT DRVR W/LATCH	782912	56289	UCN5801A	2	
U 18	ϟ IC,COMPARATOR,HI-SPEED,14 PIN DIP	647115	18324	NE522N	1	
VR 1, 2	ϟ ZENER,UNCOMP,3.3V,10%,20.0MA,0.4W	698647	04713	1N746-SR4348RL	2	
VR 3	ϟ ZENER,UNCOMP,4.7V,10%,20.0MA,0.4W	387084	04713	1N750	1	
W 1	CABLE, BOOST, B-OUT HIGH	802827	89536	802827	1	
W 2	CABLE, BOOST, B-SENSE HIGH	802850	89536	802850	1	
W 3	CABLE, BOOST HIGH VOLTAGE	802843	89536	802843	1	
X 8	SOCKET,IC,24 PIN	812198	00779	2-641932-3	1	
Z 1, 2	RES,CERM,SIP,10 PIN,9 RES,4.7K,+-2%	484063	91637	CSC10B01472G	2	
Z 4	RES,CERM,SIP,6 PIN,5 RES,4.7K,+-2%	494690	91637	CSC06B01472G	1	
Z 5	RES,CERM,SIP,6 PIN,5 RES,10K,+-2%	500876	91637	CSC06A01-103G	1	
NOTES:	ϟ Static sensitive part.					

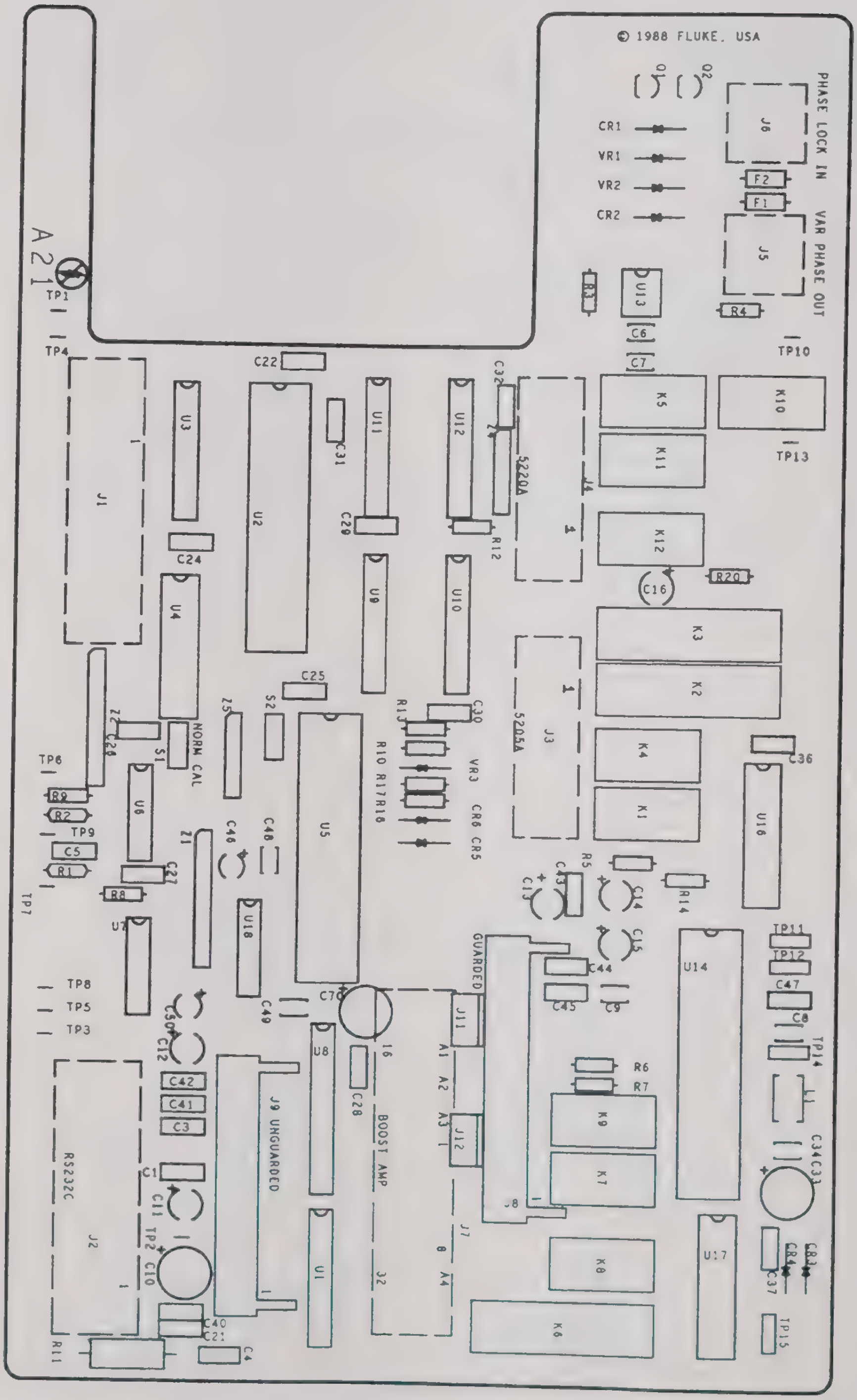


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Figure 6-26. A21 Rear Panel PCA

MANUFACTURER'S FEDERAL SUPPLY CODES

00199
Marcon Electronics Corp
Kearny, NJ

00779
AMP, Inc.
Harrisburg,PA

01121
Allen-Bradley Co.
Milwaukee, WI

01295
Texas Instruments Inc.
Semiconductor Group
Dallas,TX

02114
Amperex Electronic Corp.
Ferrox Cube Div.
Saugerties, NY

02660
Amphenol Corp.
Industrial Technology Div.
Wallingford, CT

02735
RCA Corp.
Solid State Div.
Somerville, NJ

03296
Nylon Molding Corp.
Monrovia, CA

03508
General Electric Co.
Semiconductor Products Dept.
Auburn, NY

04222
AVX Corp.
AVX Ceramics Div.
Myrtle Beach, SC

04713
Motorola Inc.
Semiconductor Products Sector
Phoenix, AZ

05276
ITT Pomona
Electronics Div.
Pomona, CA

05347
Ultronix Inc
(Tel Labs)
Grand Junction, CO

05397
Union Carbide Corp.
Materials Systems Div.
Cleveland. OH

06383
Panduit Corp.
Tinley Park, IL

06540
Amatom Electronic Hardware Div.
New Haven Mfg. Corp
New Haven, CT

06665
Analog Devices
Formerly Precision Monolithics
Santa Clara, CA

06915
Richco Plastic Co.
Chicago, IL

07047
Ross Milton Co., The
Southampton, PA

07263
Fairchild Semiconductor
North American Sales
Cupertino, CA

07910
Teledyne Inc. Co.
Replaced by:
15818
Teledyne Semiconductor

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, AZ

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, NY

09969
Dale Electronics Inc.
Yankton, SD

0AKZ5
Crane Electronics
Cincinnati, Ohio

0BW21
Noritake Co. Inc.
Burlington, MA

0CLN7
Emhart Fastening Group
Shelton, CT

0GZV8
Huber and Suhner Inc.
Essex, VT

10389
ITW Switches
Div. of Illinois Tool Works Inc.
Chicago, IL

11532
Teledyne Relays
Teledyne Industries Inc.
Sub of Teledyne Inc.
Hawthorne, CA

12581
Hitachi Metals Inernational Ltd.
Div. of Hitachi Magna-Lock
Big Rapids, MI

12969
Unitrode Corp.
Lexington, MA

13103
Thermalloy Co., Inc.
Dallas, TX

13919
Burr-Brown Corp.
Tucson, AZ

14099
Semtech Corp.
Newbury Park, CA

14329
Wells Electronics Inc.
South Bend, IN

14552
Microsemi Corp.
(Formerly Micro-Semiconductor)
Santa Ana, CA

17856
Siliconix Inc.
Santa Clara, CA

18324
Signetics Corp.
Military Products Div.
Orem, UT

19647
Caddock Electronics Inc.
Riverside, CA

19701
Philips Components
Formerly Mepco/Centralab Inc.
A North American Philips Co.
El Paso, TX

1EJ84
Raychem Corp.
Electronics Div.
Hanover, MD
Replaced by 4Z785

21845
Solitron Devices Inc.
Corp Hq & Semiconductor Mfg.
Group
Riviera Beach, FL

22526
DuPont, El DeNemours & Co. Inc.
DuPont Connector Systems
New Cumberland, PA

23237
I R C, Inc.
Microcircuits Div
Philadelphia, PA

23783
Brel
International Components
Sarasota, FL

24347
Penn Engineering Co.
S. El Monte, CA

24355
Analog Devices Inc.
Norwood, MA

24444
General Semiconductor
Industries, Inc.
Tempe, AZ

24759
Lenox-Fugle Electronics Inc.
South Plainfield, NJ

24931
Specialty Connector Co.
Franklin, IN

25088
Siemens Corp.
Iselin, NJ

26402
Lumex,Inc.
Bayshore, NY

27014
National Semiconductor Corp.
Santa Clara, CA

27264
Molex Inc.
Lisle, IL

28198
Positronic Industries Inc.
Springfield, MO

28213
Minnesota Mining & Mfg. Co.
Consumer Specialties Div. 3M Center
Saint Paul, MN

28480
Hewlett-Packard Co.
Corporate HQ
Palo Alto, CA

2M530
John Perine
Seattle, WA

30161
Aavid Engineering Inc.
Laconia, NH

30800
General Instrument Corp.
Capacitor Div.
Hicksville, NY

31433
Kemet Electonics Corp.
Simpsonville, SC

31918
ITT/Schadow Inc.
Eden Prairie, MN

32559
Bivar, Inc.
Irvine, CA

32997
Bourns Inc.
Trimpot Div.
Riverside, CA

33297
NEC Electronics USA Inc.
Electronic Arrays Inc. Div.
Mountain View, CA

34333
Silicon General Inc.
Garden Grove, CA

34335
Advanced Micro Devices (AMD)
Sunnyvale, CA

34371
Harris Corp.
Semiconductor Sector
Melbourne, FL

40402
Intelogic Trace Inc.
Arlington, VA

MANUFACTURER'S FEDERAL SUPPLY CODES (CONT)

40551
Milford Rivet & Machine Co.
Milford, CT

46384
Penn Engineering & Mfg. Corp.
Danboro, PA

50579
Siemens Components Inc.
Optoelectronics Div.
Cupertino, CA

51406
Murata Erie, No. America Inc.
Symma, GA

54343
Treco Electronics Inc.
DBA Riedon
Alhambra, CA

54583
TDK Electronics Corp.
Port Washington, NY

54590
RCA Corp.
Distribution & Special Products
Cherry Hill, NJ

55285
Bercquist Co. Inc., The
Minneapolis, MN

55322
Samtec Inc.
New Albany, IN

55464
Central Semiconductor Corp.
Div. of Central State Industries,Inc.
Hauppauge, NY

55566
RAF Electronic Hardware Inc.
Seymour, CT

56289
Sprague Electric Co.
Nashua, NH

59124
KOA Speer Electronics Inc.
Bradford, PA

59640
Supertex Inc.
Sunnyvale, CA

59660
Tusonix Inc.
Tucson, AZ

59730
Thomas and Betts Corp.
Iowa City, IA

5W664
NDK America Inc.
Div. of Nihon Dempa Kogyo LTD
Lynchburg, VA

60046
Power Dynamics Inc.
West Orange, NJ

60705
Cera-Mite Corp.
Grafton, WI

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, IN

61058
Matsushita Electric Corp. of America
Panasonic Industrial Co. Div
Secaucus, NJ

61429
Fox Electronics
Fort Myers, FL

61529
Aromat Corp.
New Providence, NJ

61935
Schurter Inc.
Petaluma, CA

62643
United Chemi-con Inc.
Rosemont, IL

62786
Hitachi America Ltd.
Semiconductor & IC Div.
San Jose, CA

64155
Linear Technology
Milpitas, CA

64762
Elantec Inc.
Milipitas, CA

65940
Rohm Corp
Irvine, CA

66419
Exel Microelectronics Inc.
San Jose, CA

66891
BKC International Electronics Inc.
Lawrence, MA

67237
Saft America Inc.
Portable Battery Div.
Valdosta, GA

68919
Inter-Technical Group Inc., The
Wima Division
Elmsford, NY

70903
Cooper Belden Electronic Wire & Cable
Geneva, IL

71400
Bussman - Now Magnum
Div. of Cooper Industries Inc.
St. Louis, MO

71450
CTS Corp.
West Lafayette, IN

71643
CHR Industries, Inc.
(Formerly Connecticut Hard Rubber Co.)
New Haven, CT

71707
Coto Corp.
Providence, RI

72982
Erie Specialty Products, Inc
Formerly: Murata Erie, OPNS
Erie, PA

73445
Amperex Electronic Corp.
Hicksville, NY

73734
Federal Screw Products Inc.
Chicago, IL

74594
Component Resources Inc.
Div of EPI International Corp.
Beaverton, OR

74840
Illinois Capacitor Inc.
Lincolnwood, IL

74970
Johnson EF Co.
Waseca, MN

75915
Littelfuse Tracor, Inc.
(Formerly: Tracor-Littelfuse)
Des Plaines, IL

77342
Potter & Brumfield Inc.
A Siemens Co.
Princeton, IN
Formerly AMF Inc.

78189
Illinois Tool Works Inc.
Shakeproof Div.
Elgin, IL

79727
C-W Industries (Continental Wirt)
Southampton, PA

79963
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Mepco/Electra Inc.
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83330
Dialight Corp.
Manasquan Div.
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84411
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Ogallala Opns
Ogallala, NE

86928
Seastrom Mfg. Co. Inc.
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Litton Systems-Useco Div.
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91833
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Tuckahoe, NY

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93790
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New Bedford, MA

96341
M/A-Com Inc.
Burlington, MA

98291
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98978
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Section 7

Schematic Diagrams

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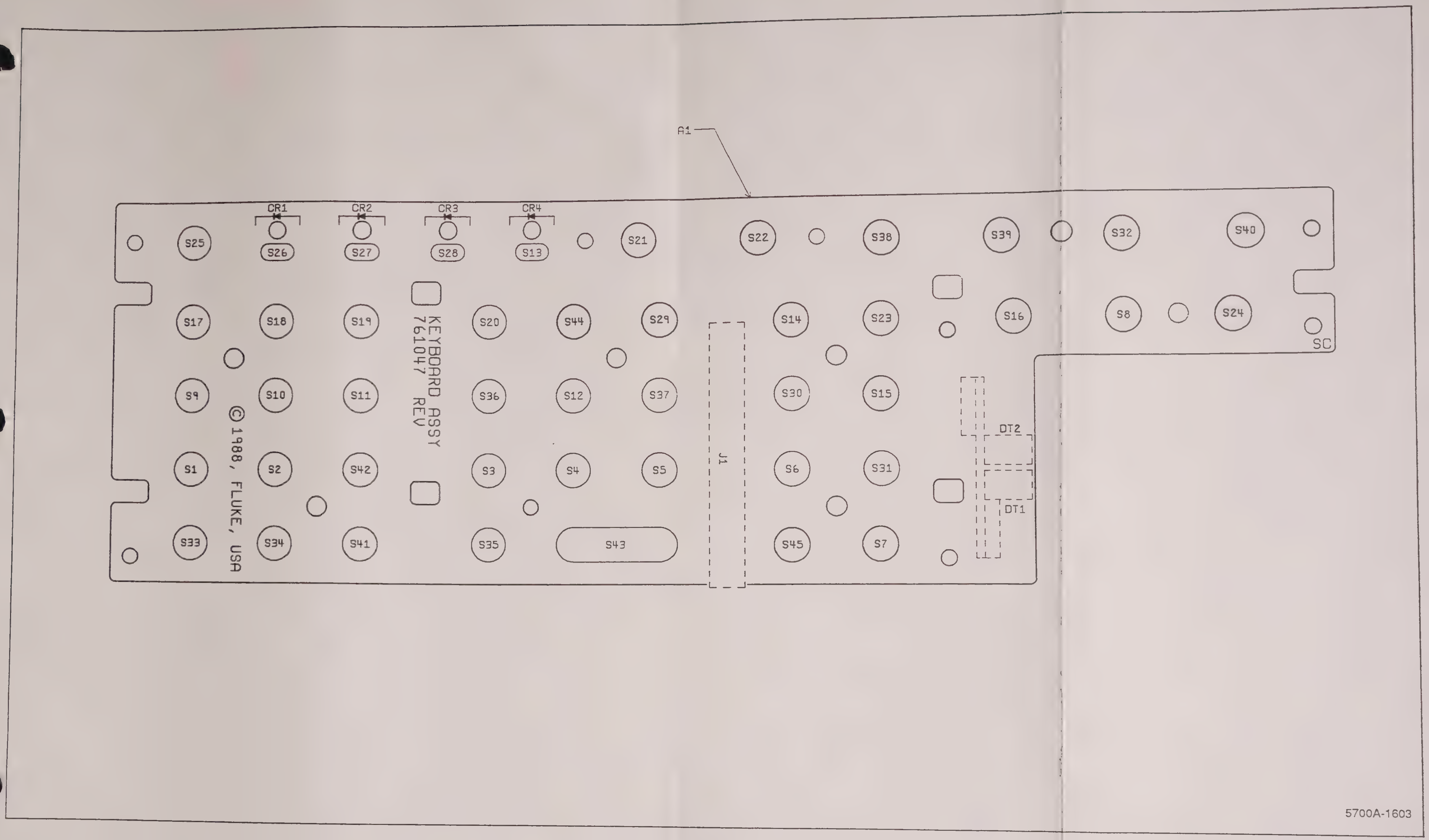


Figure 7-1. A1 Keyboard PCA

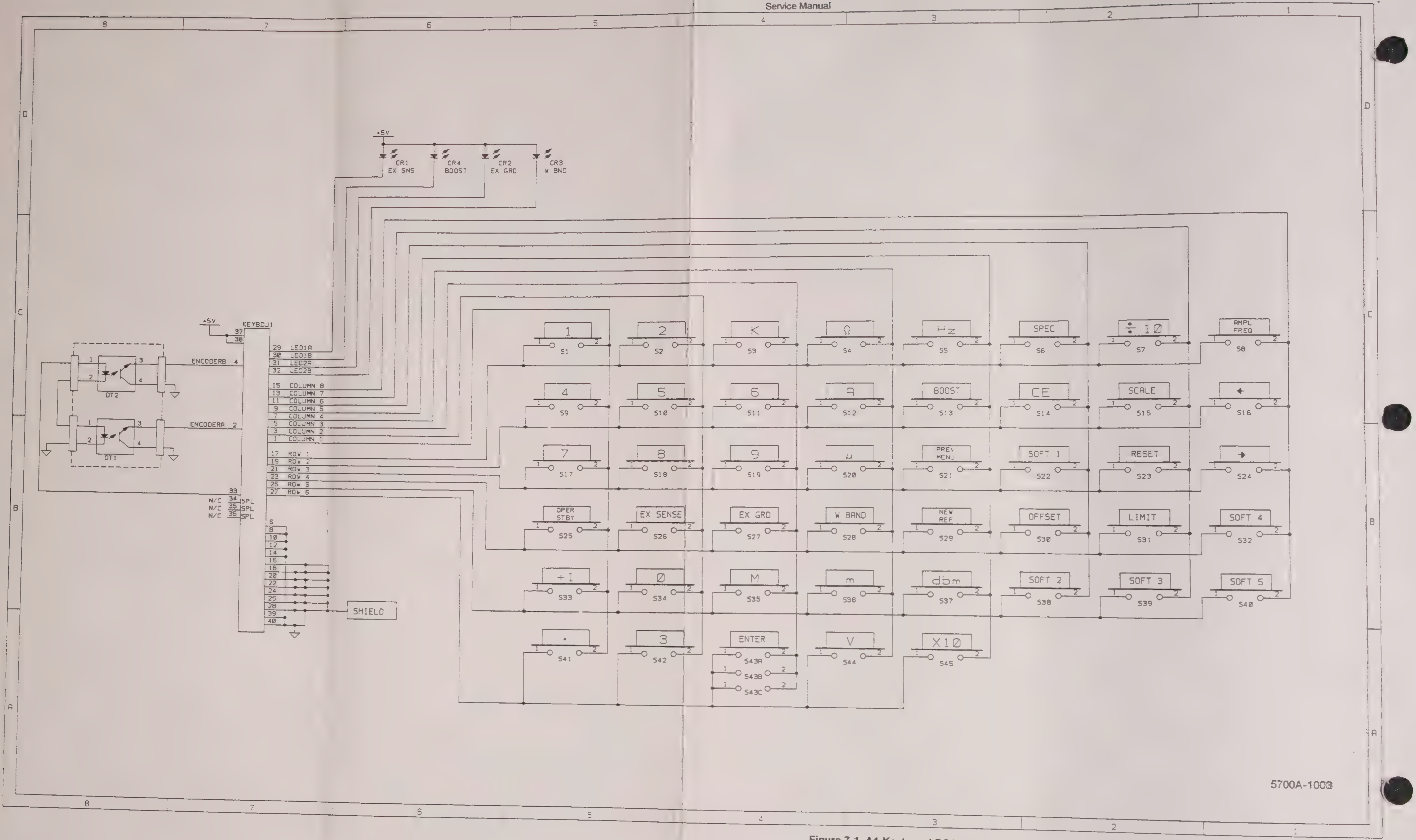


Figure 7-1. A1 Keyboard PCA (cont)

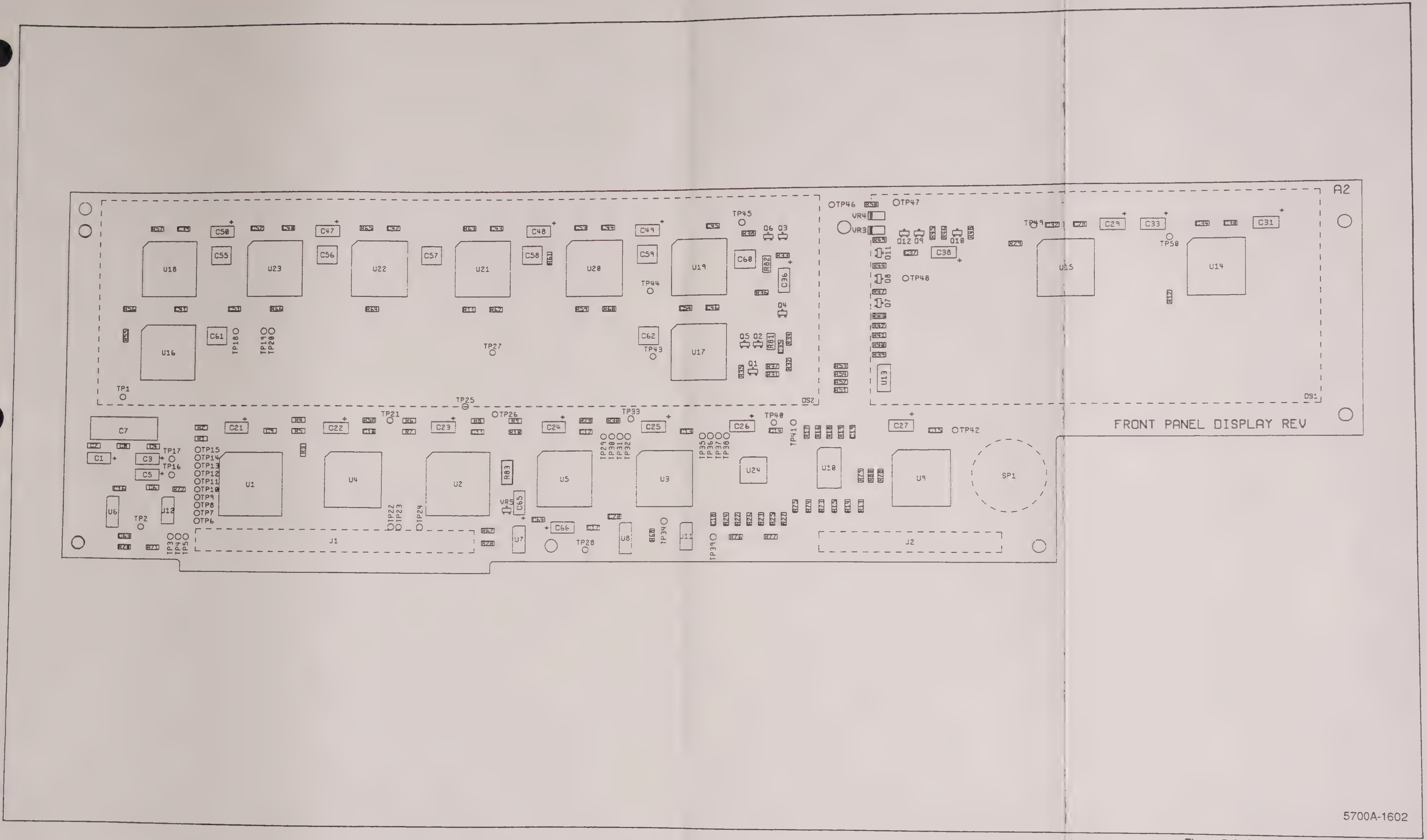
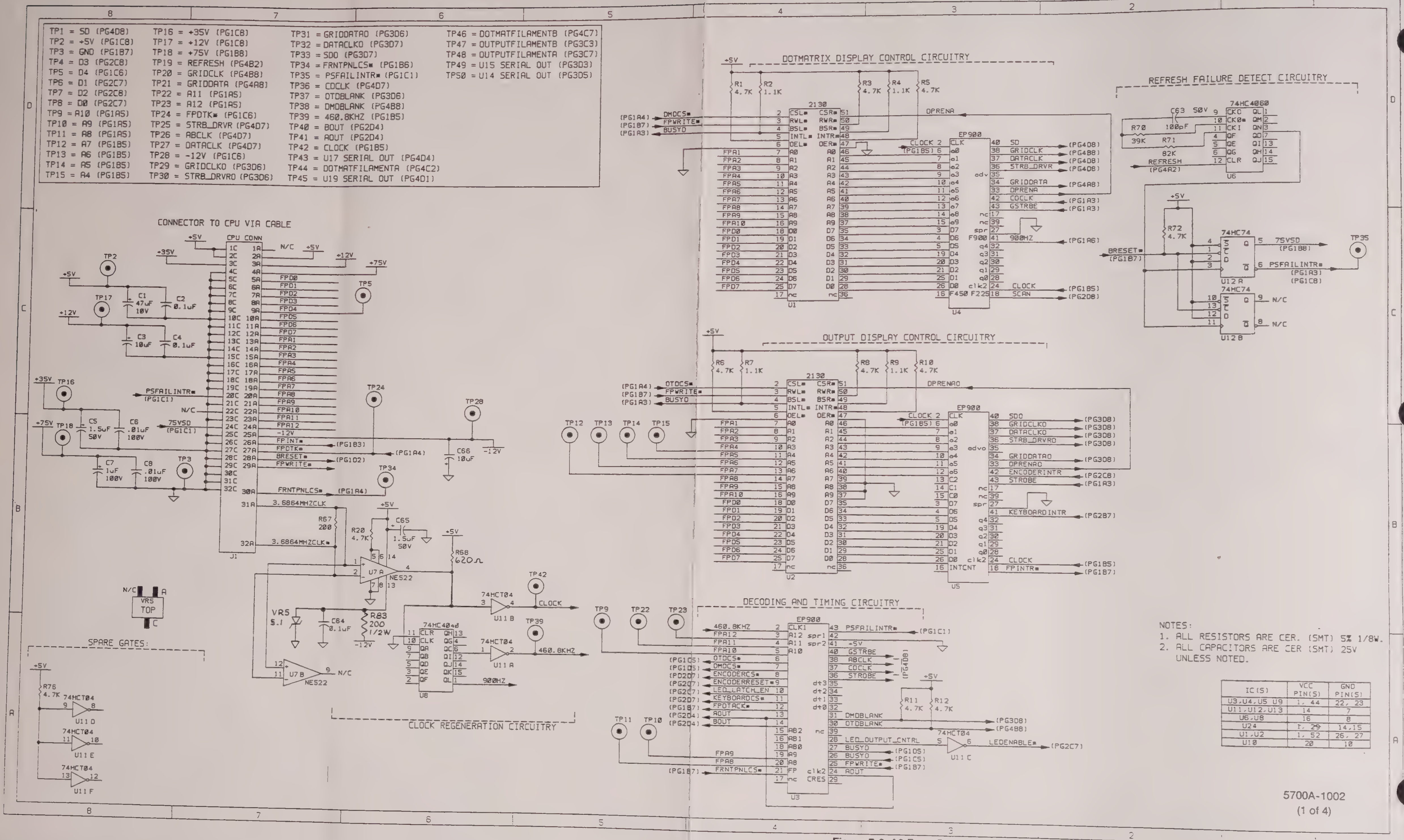


Figure 7-2. A2 Front Panel PCA


DOTMATRIX DISPLAY CONTROL CIRCUITRY
REFRESH FAILURE DETECT CIRCUITRY
CONNECTOR TO CPU VIA CABLE
OUTPUT DISPLAY CONTROL CIRCUITRY
DECODING AND TIMING CIRCUITRY
CLOCK REGENERATION CIRCUITRY
SPARE GATES:
2130
EP900
74HC4060
74HC74
74HC4040
74HCT04
NE522
J1
U1
U2
U3
U4
U5
U6
U8
U7 A
U7 B
U12 A
U12 B
U11 A
U11 B
U11 C
U11 D
U11 E
U11 F
VR5 TOP

TP1 = SD (PG4D8)
TP2 = +5V (PG1C8)
TP3 = GND (PG1B7)
TP4 = D3 (PG2C8)
TP5 = D4 (PG1C6)
TP6 = D1 (PG2C7)
TP7 = D2 (PG2C8)
TP8 = D0 (PG2C7)
TP9 = A10 (PG1A5)
TP10 = A9 (PG1A5)
TP11 = A8 (PG1A5)
TP12 = A7 (PG1B5)
TP13 = A6 (PG1B5)
TP14 = A5 (PG1B5)
TP15 = A4 (PG1B5)
TP16 = +35V (PG1C8)
TP17 = +12V (PG1C8)
TP18 = +75V (PG1B8)
TP19 = REFRESH (PG4B2)
TP20 = GRIDCLK (PG4B8)
TP21 = GRIDDATA (PG4A8)
TP22 = A11 (PG1A5)
TP23 = A12 (PG1A5)
TP24 = FPDTK* (PG1C6)
TP25 = STRB_DRVR (PG4D7)
TP26 = ABCLK (PG4D7)
TP27 = DATACLK (PG4D7)
TP28 = -12V (PG1C6)
TP29 = GRIDCLKO (PG3D6)
TP30 = STRB_DRVRO (PG3D6)
TP31 = GRIDDATAO (PG3D6)
TP32 = DATACLKO (PG3D7)
TP33 = SDO (PG3D7)
TP34 = FRNTPNLCS* (PG1B6)
TP35 = PSFAILINTR* (PG1C1)
TP36 = CDCLK (PG4D7)
TP37 = OTDBLANK (PG3D6)
TP38 = DMDBLANK (PG4B8)
TP39 = 460.8KHZ (PG1B5)
TP40 = BOUT (PG2D4)
TP41 = AOUT (PG2D4)
TP42 = CLOCK (PG1B5)
TP43 = U17 SERIAL OUT (PG4D4)
TP44 = DOTMATFILAMENTA (PG4C2)
TP45 = U19 SERIAL OUT (PG4D1)
TP46 = DOTMATFILAMENTB (PG4C7)
TP47 = OUTPUTFILAMENTB (PG3C3)
TP48 = OUTPUTFILAMENTA (PG3C7)
TP49 = U15 SERIAL OUT (PG3D3)
TP50 = U14 SERIAL OUT (PG3D5)

NOTES:
1. ALL RESISTORS ARE CER. (SMT) 5% 1/8W.
2. ALL CAPACITORS ARE CER (SMT) 25V UNLESS NOTED.

IC(S)	VCC PIN(S)	GND PIN(S)
U3,U4,U5 U9	1, 44	22, 23
U11,U12,U13	14	7
U6,U8	16	8
U24	1, 29	14,15
U1,U2	1, 52	26, 27
U10	20	10

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(1 of 4)

Figure 7-2. A2 Front Panel PCA (cont)

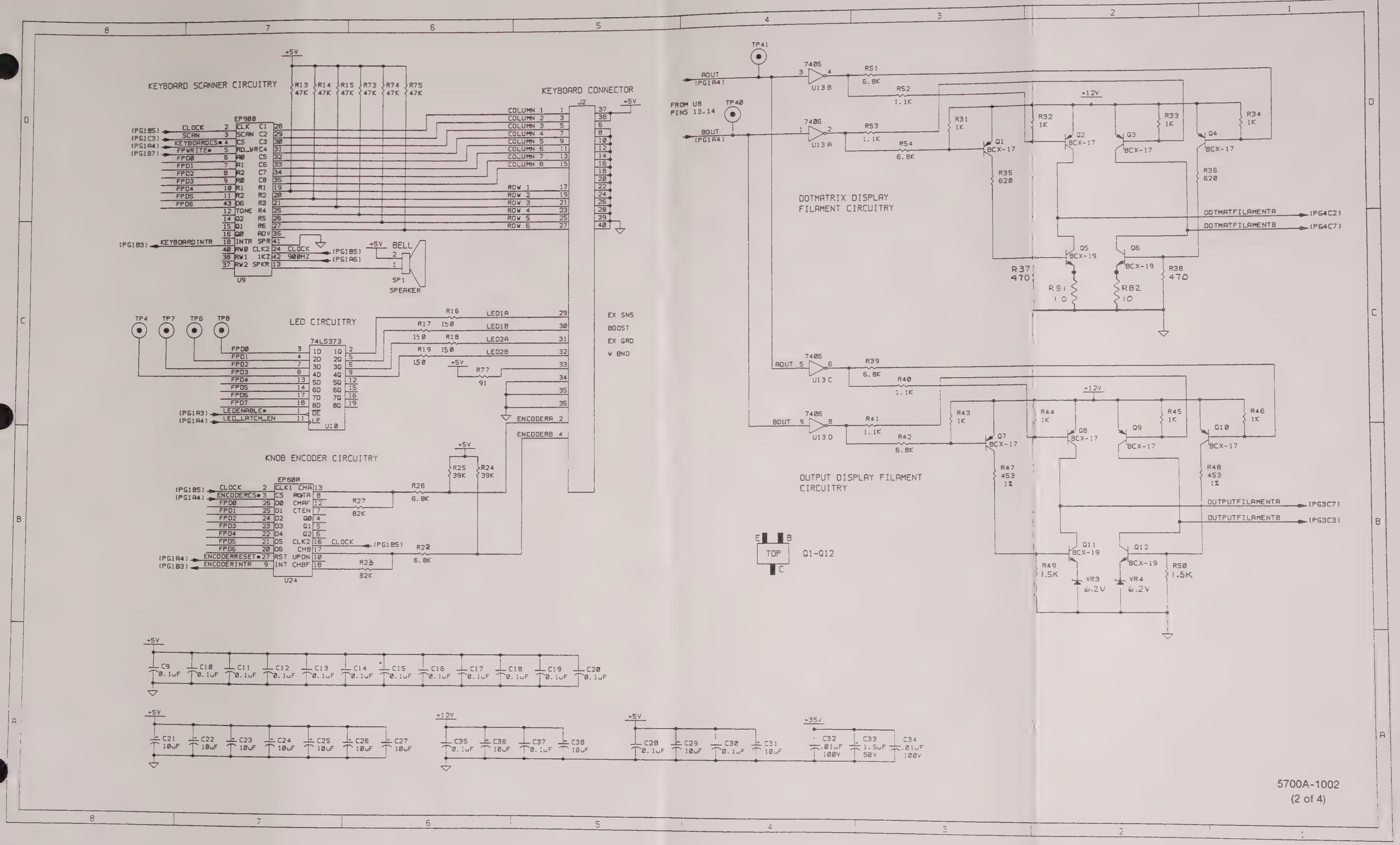


Figure 7-2. A2 Front Panel PCA (cont)

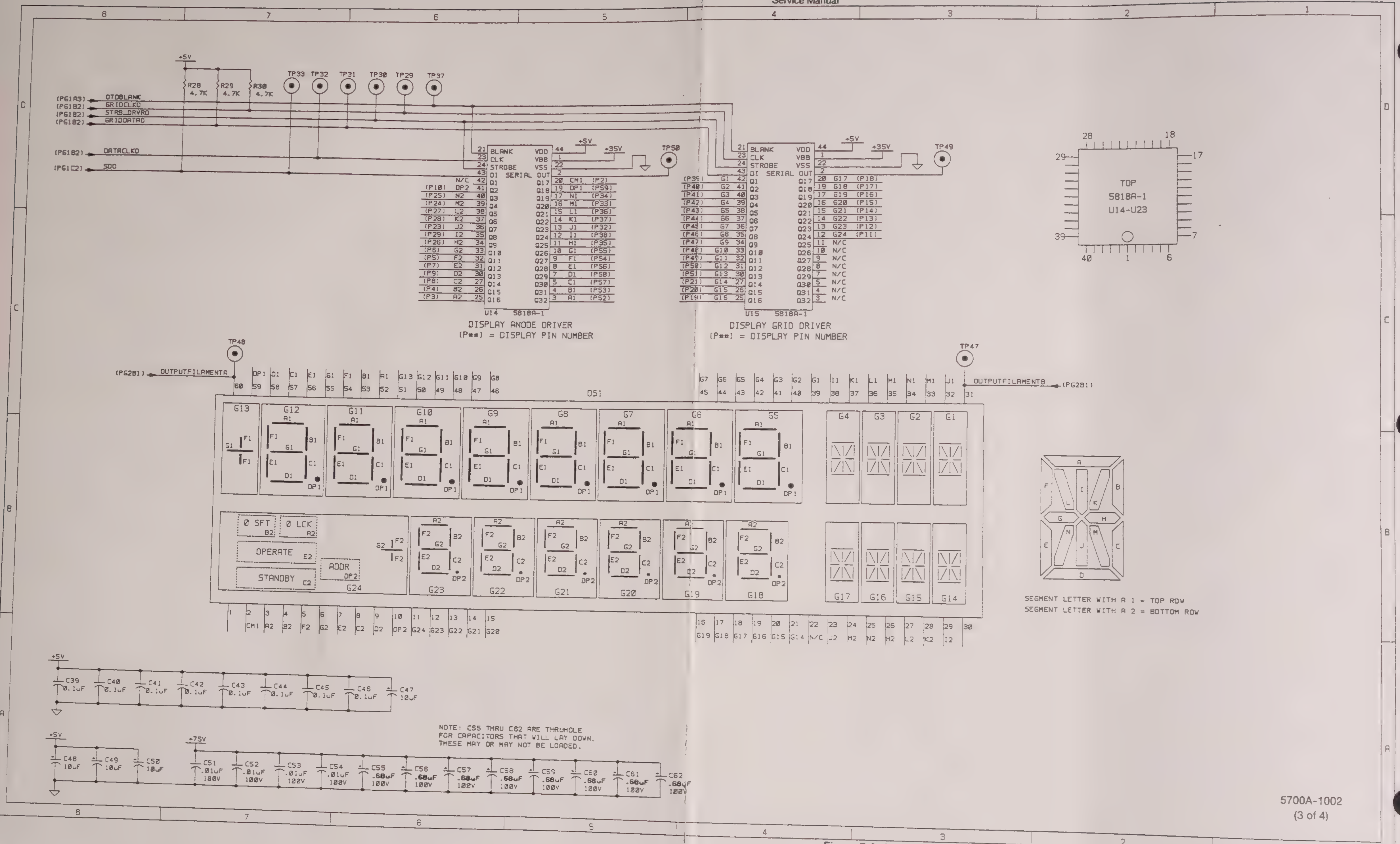


Figure 7-2. A2 Front Panel PCA (cont)

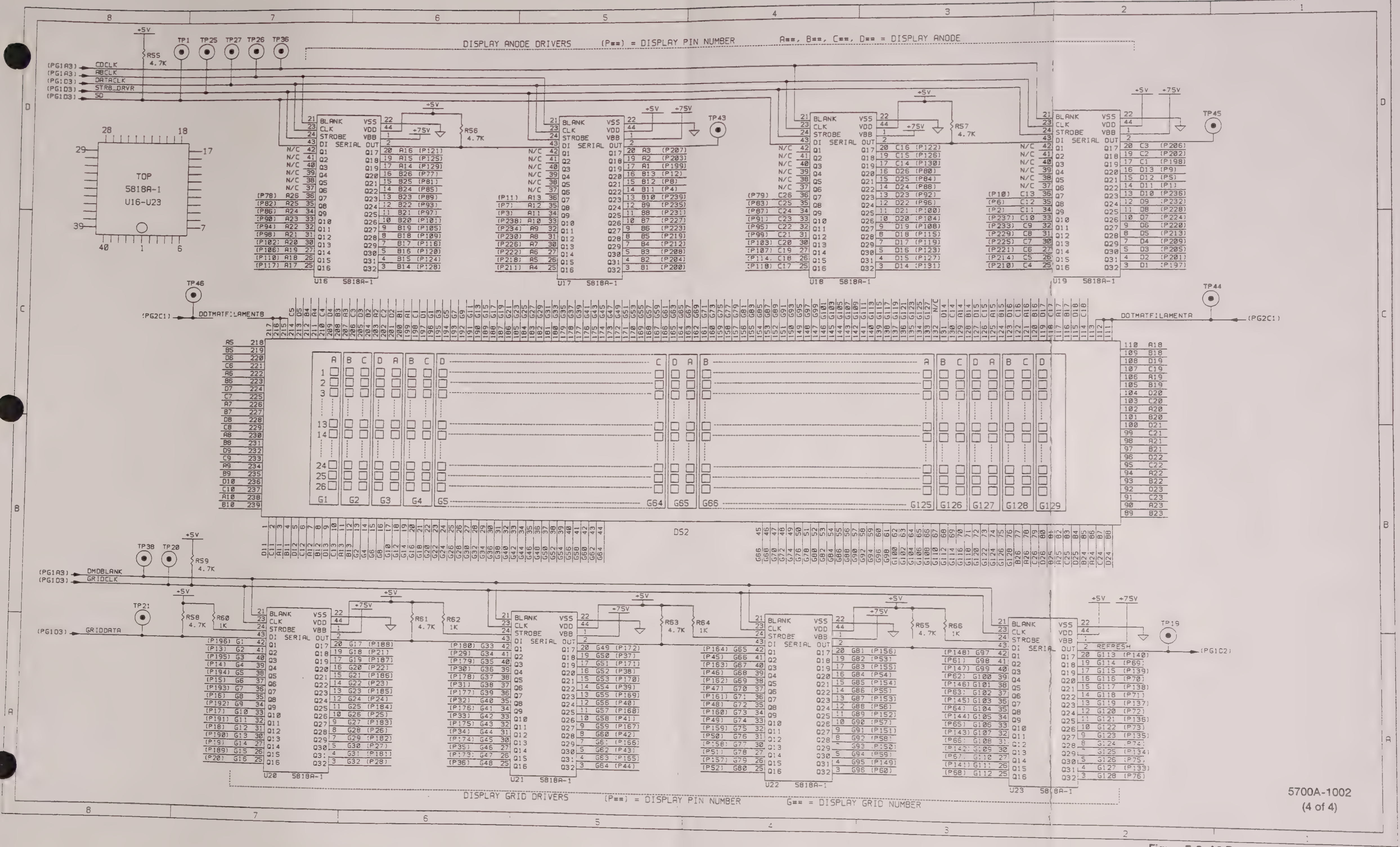


Figure 7-2. A2 Front Panel PCA (cont)

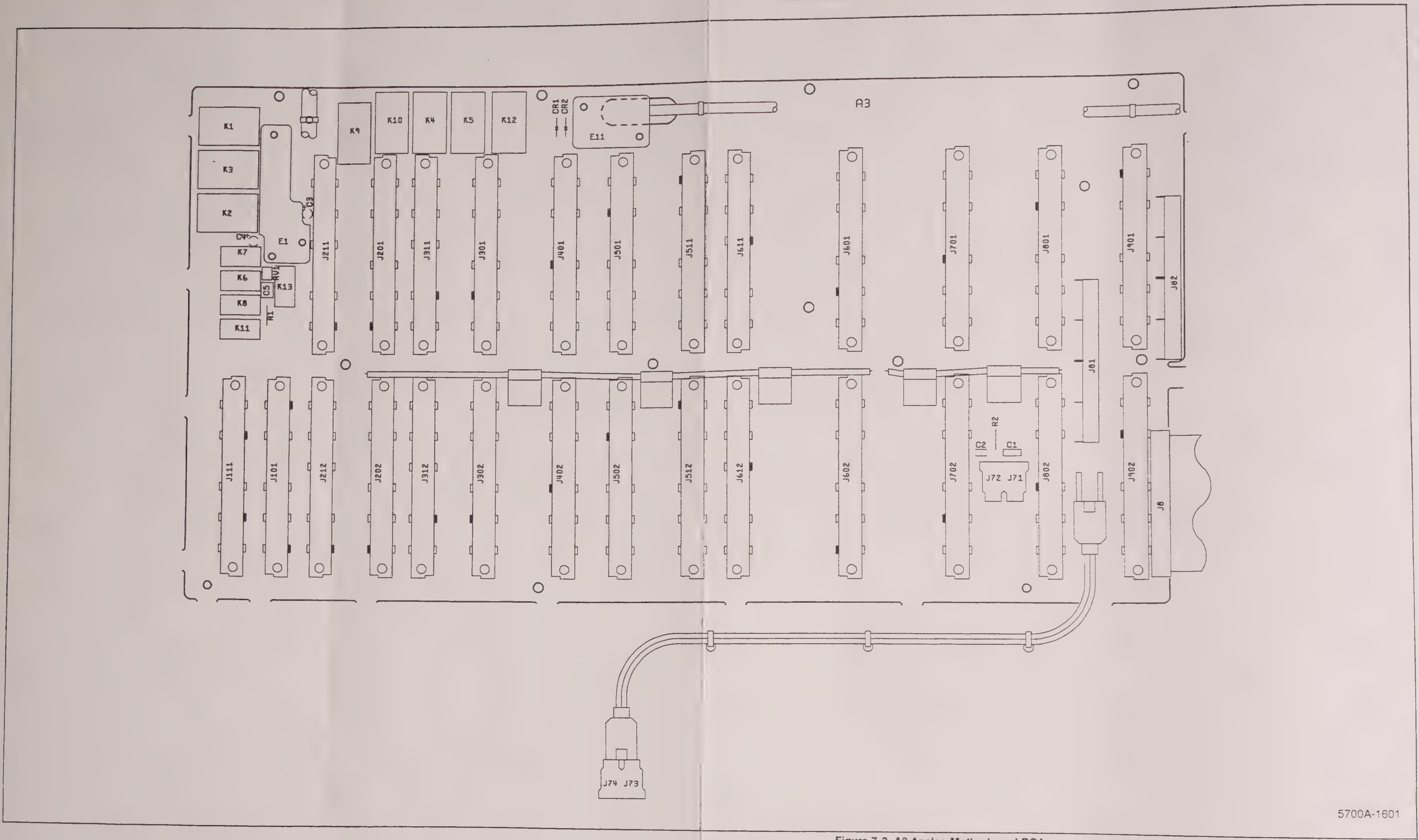


Figure 7-3. A3 Analog Motherboard PCA

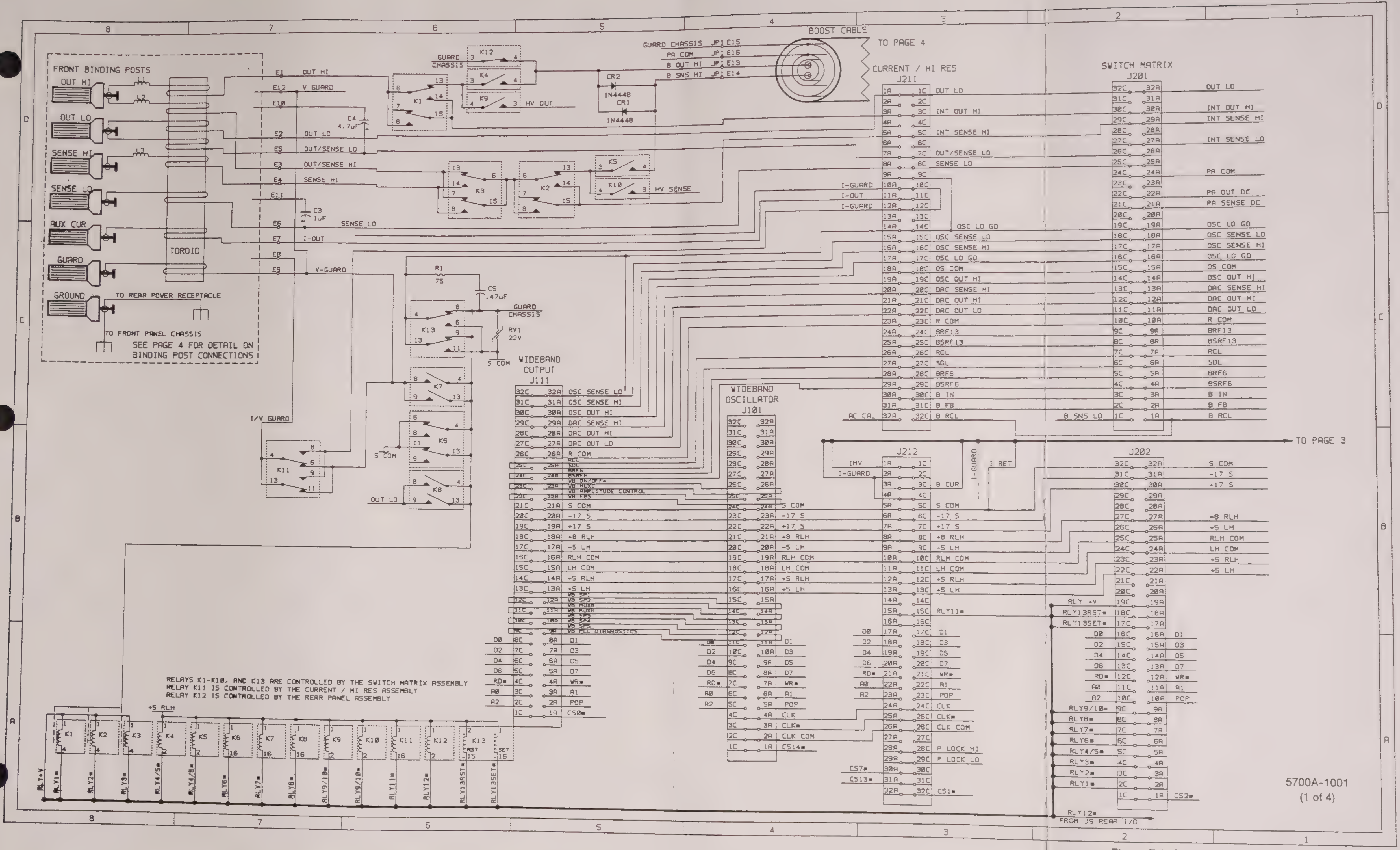


Figure 7-3. A3 Analog Motherboard PCA (cont)

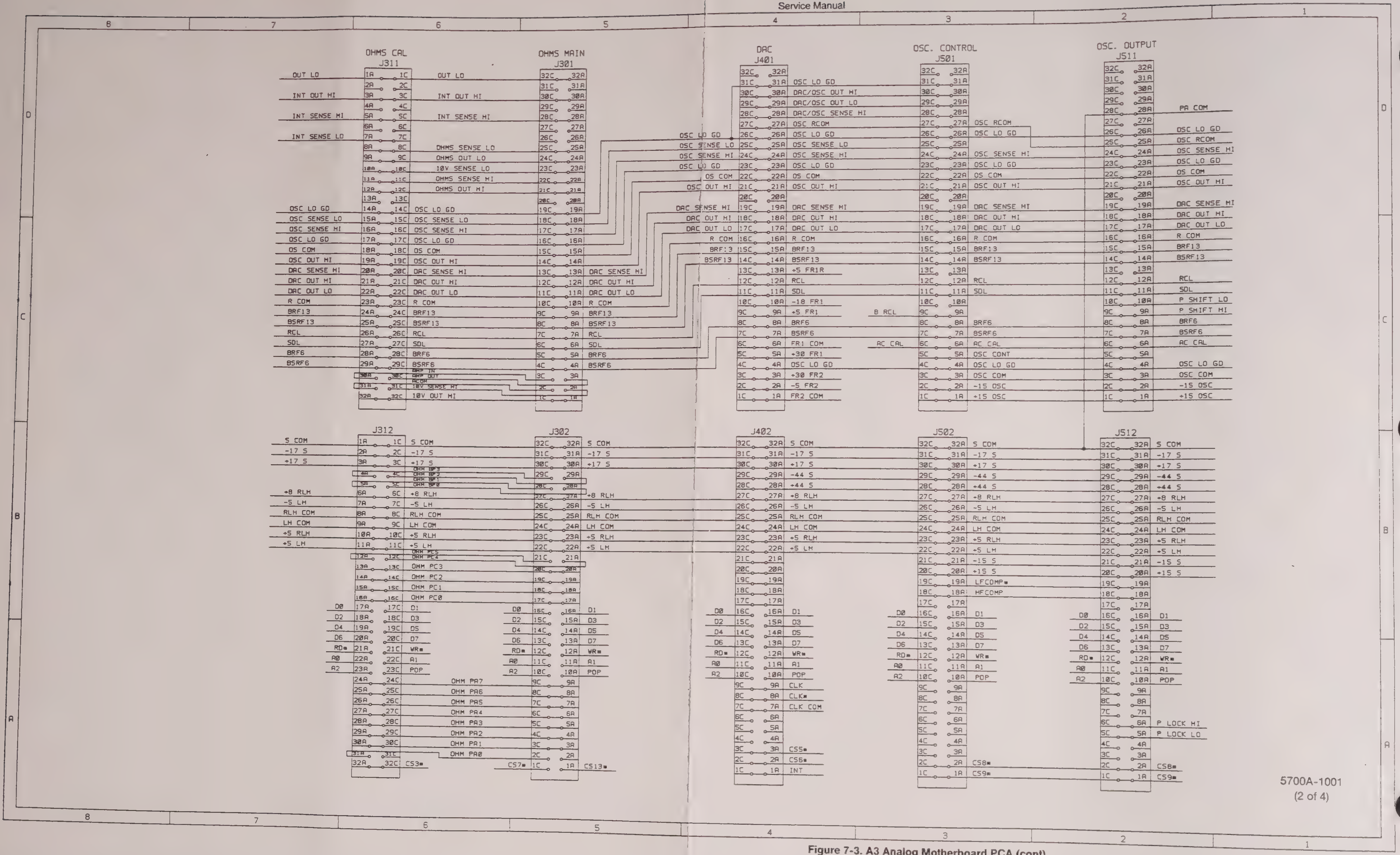


Figure 7-3. A3 Analog Motherboard PCA (cont)

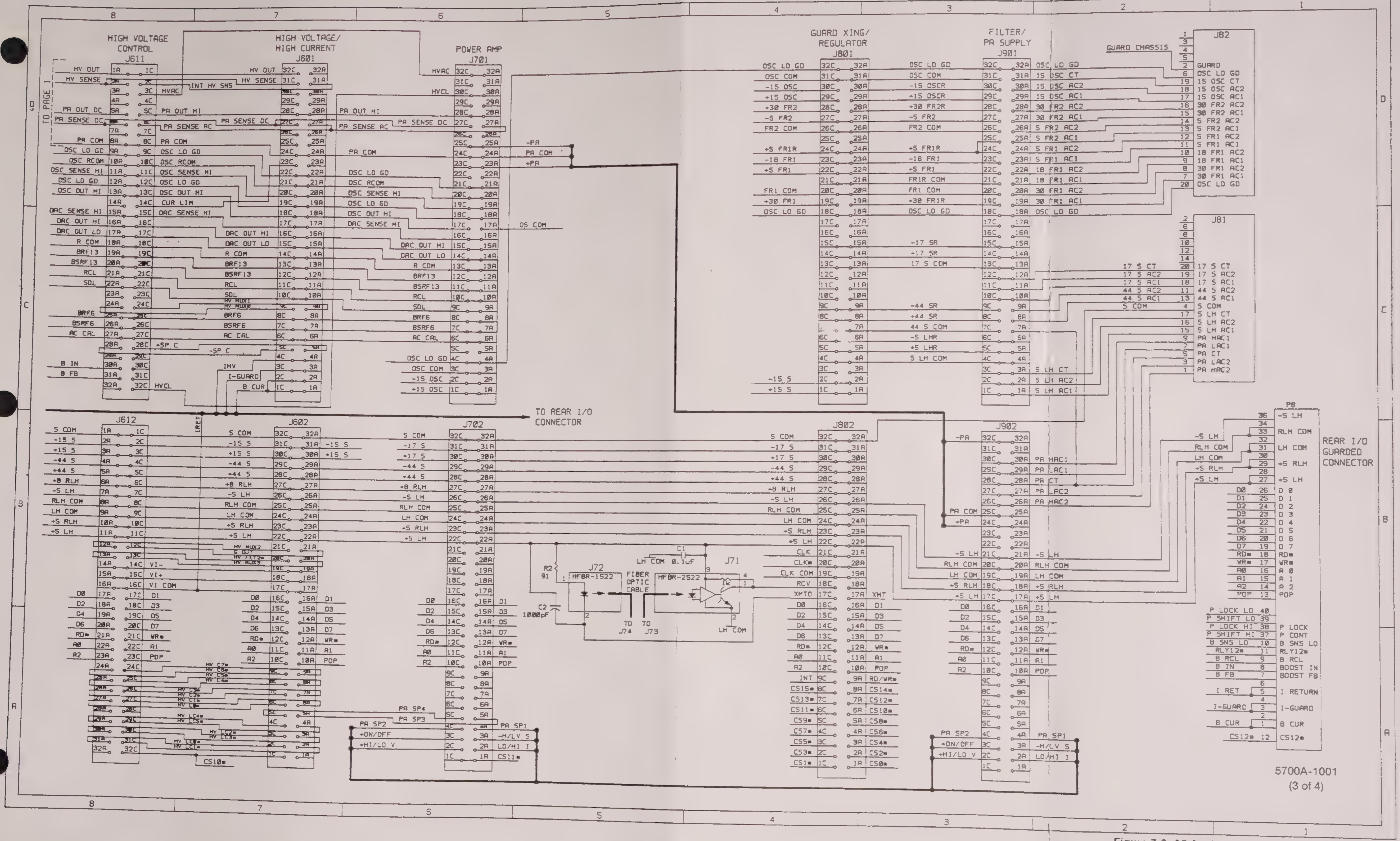


Figure 7-3. A3 Analog Motherboard PCA (cont)

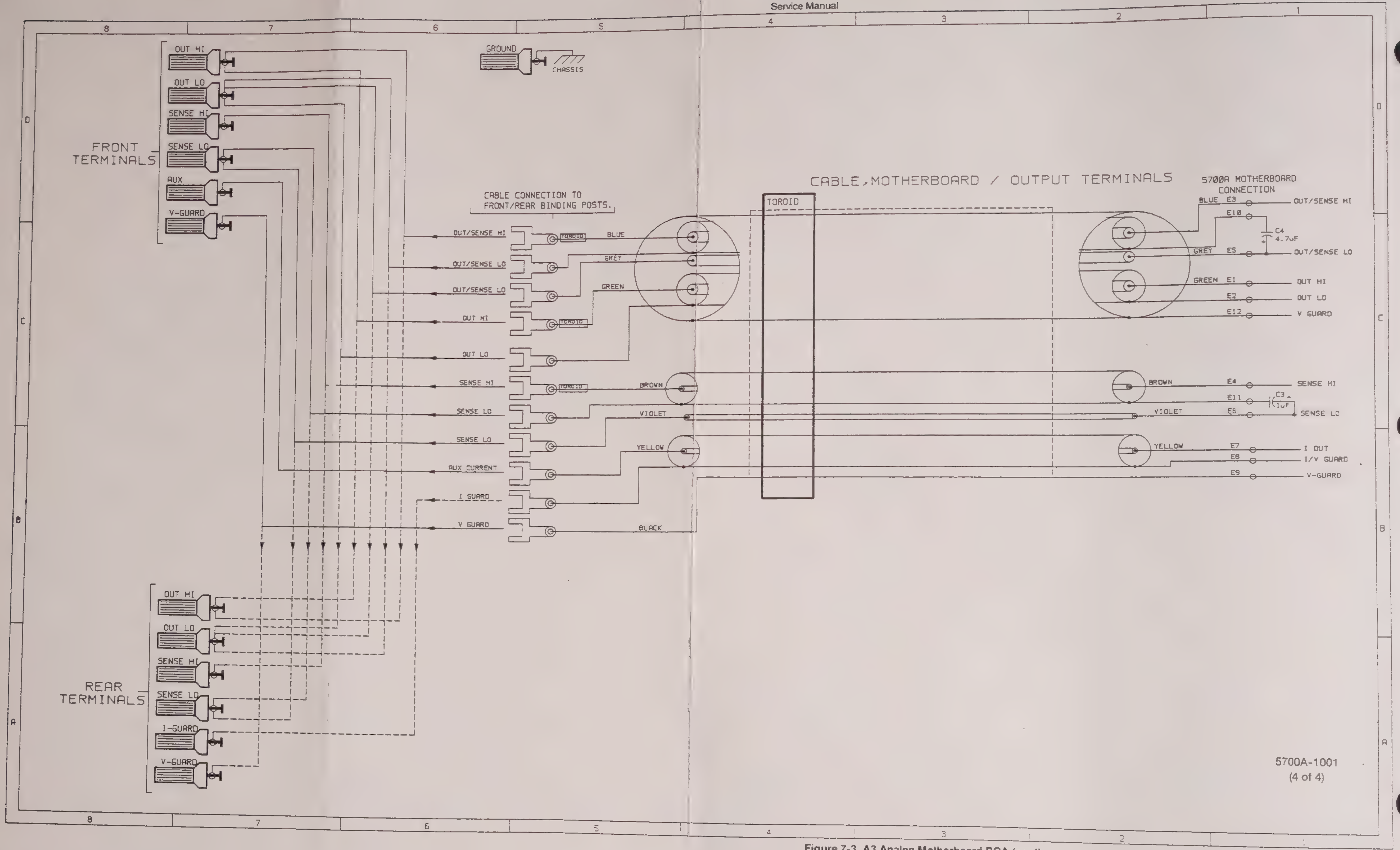


Figure 7-3. A3 Analog Motherboard PCA (cont)

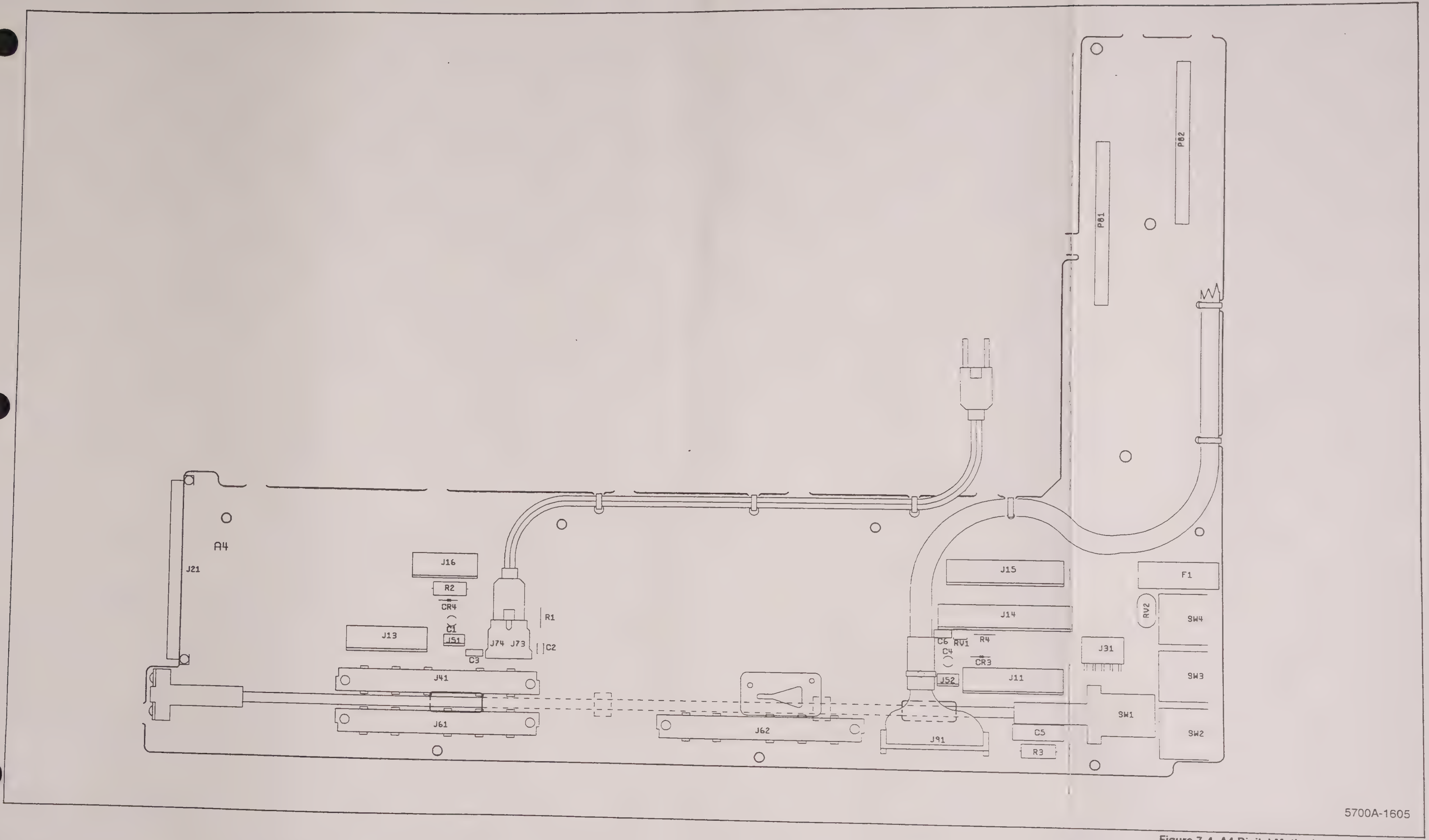
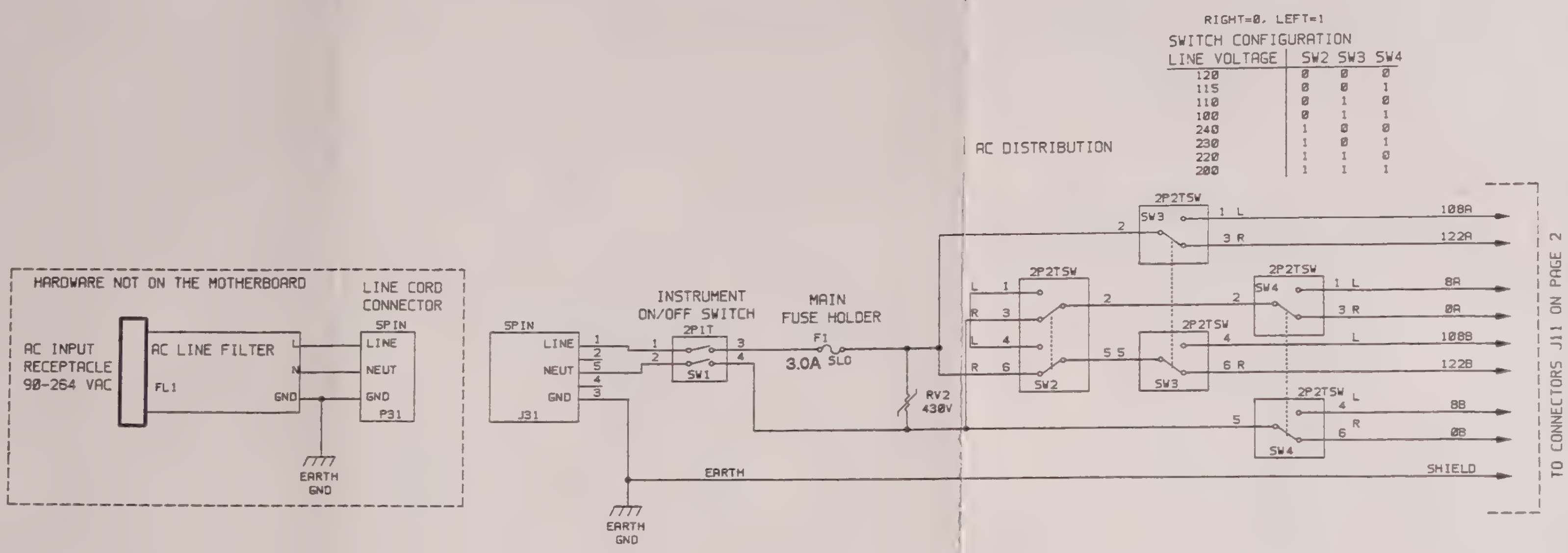


Figure 7-4. A4 Digital Motherboard PCA



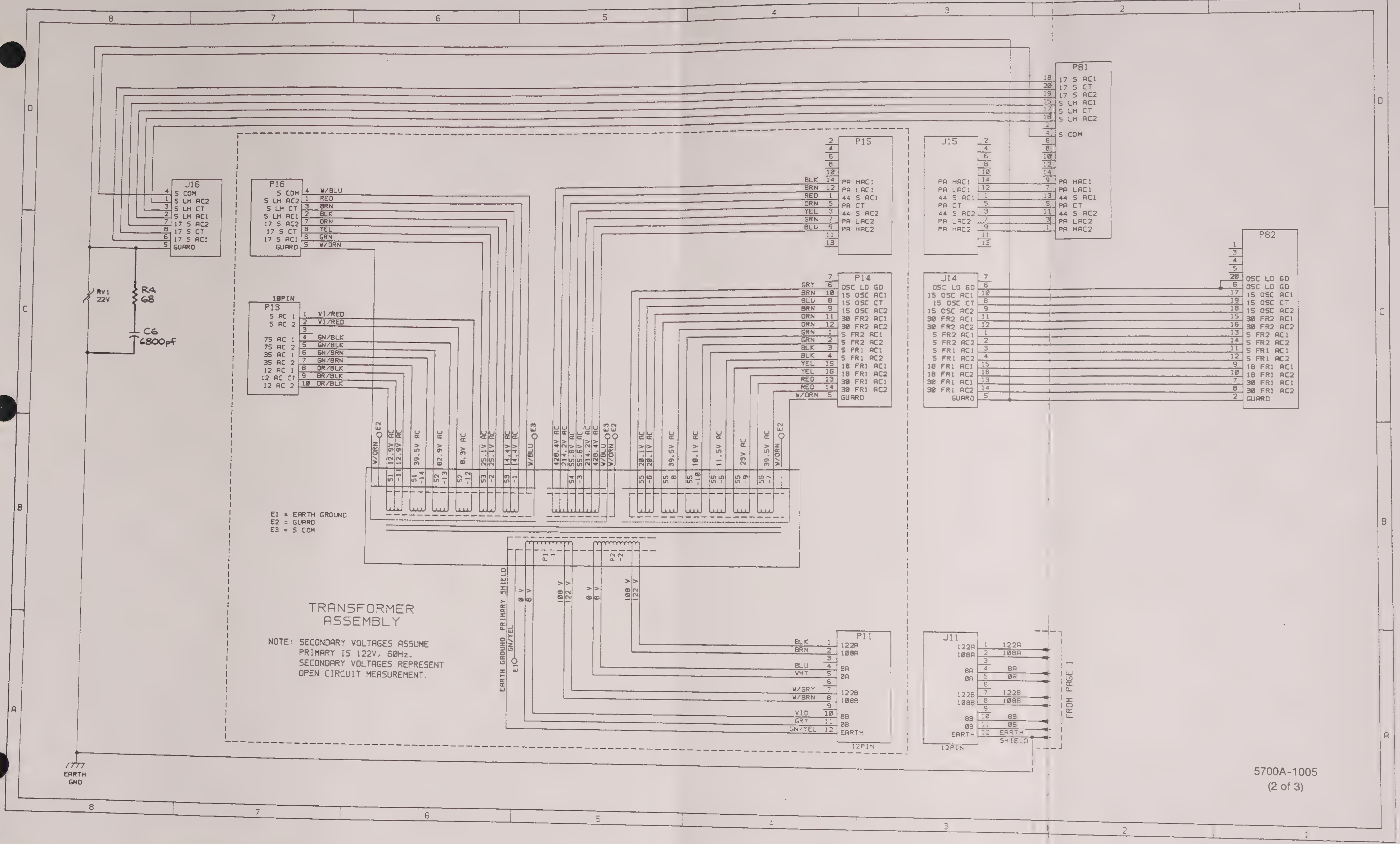
RIGHT=0, LEFT=1

SWITCH CONFIGURATION

LINE VOLTAGE	SW2	SW3	SW4
120	0	0	0
115	0	0	1
110	0	1	0
100	0	1	1
240	1	0	0
230	1	0	1
220	1	1	0
200	1	1	1

5700A-1005
(1 of 3)

Figure 7-4. A4 Digital Motherboard PCA (cont)



E1 = EARTH GROUND
E2 = GUARD
E3 = S COM

TRANSFORMER ASSEMBLY

NOTE: SECONDARY VOLTAGES ASSUME PRIMARY IS 122V, 60Hz. SECONDARY VOLTAGES REPRESENT OPEN CIRCUIT MEASUREMENT.

5700A-1005
(2 of 3)

Figure 7-4. A4 Digital Motherboard PCA (cont)

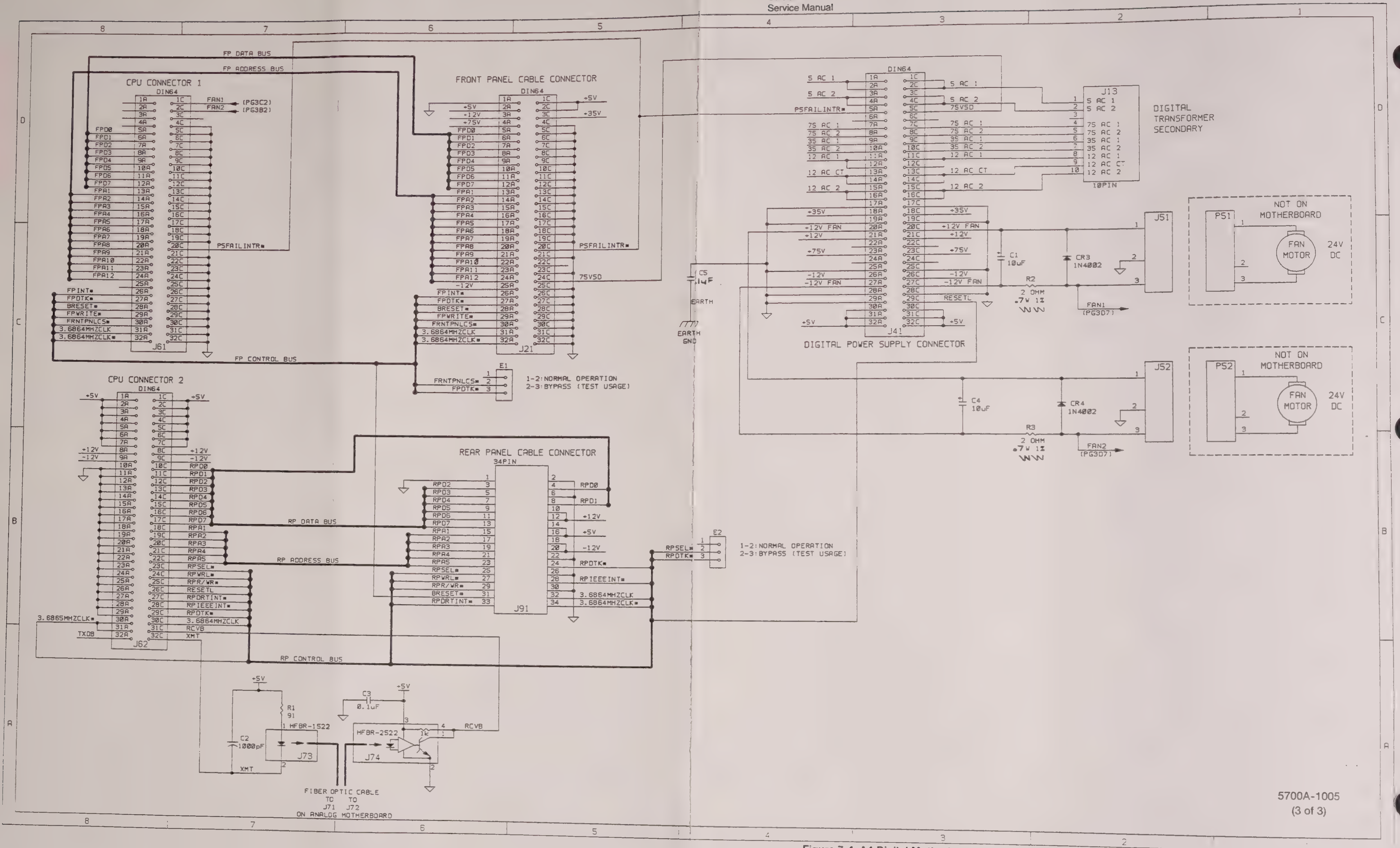


Figure 7-4. A4 Digital Motherboard PCA (cont)

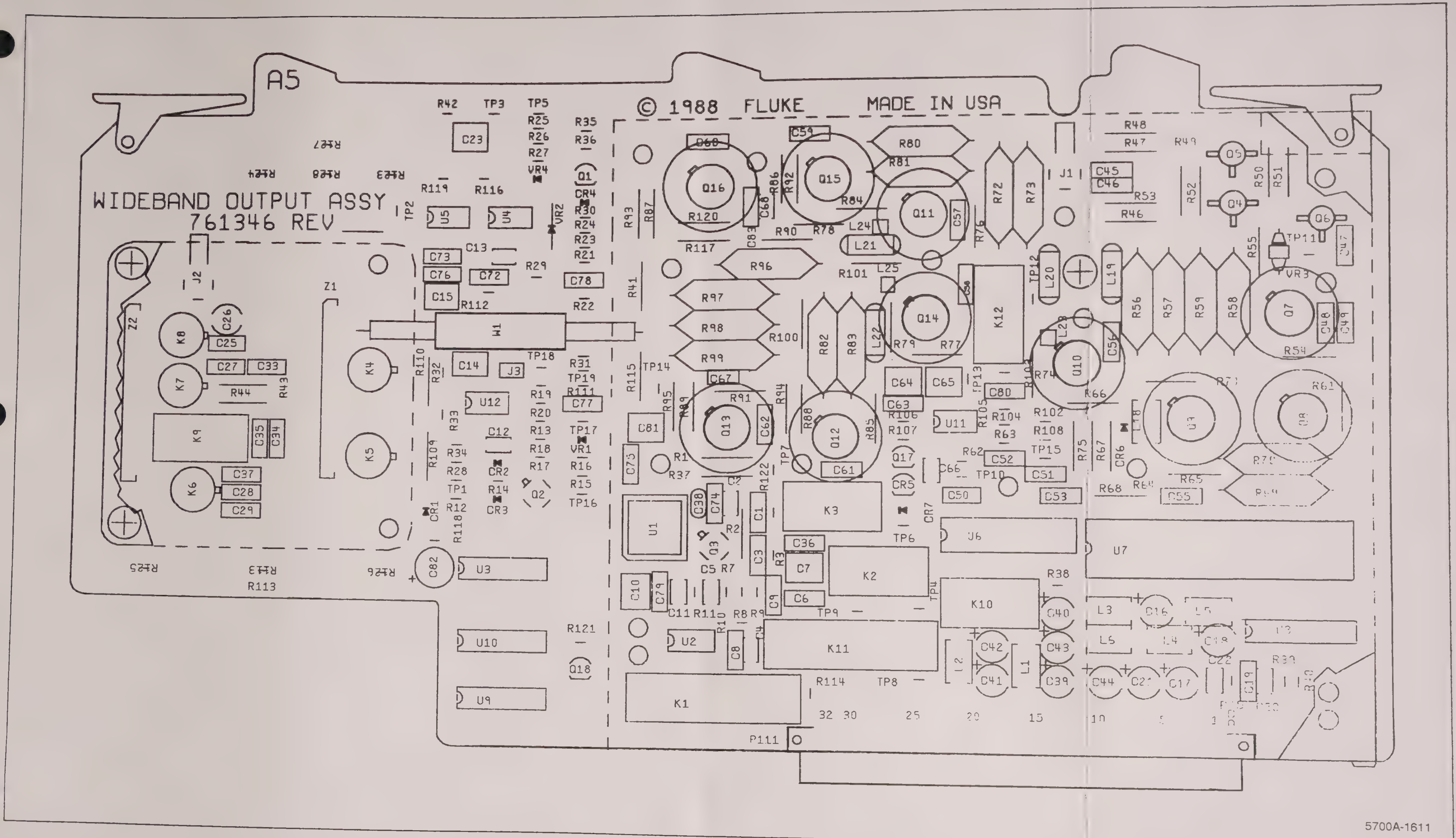
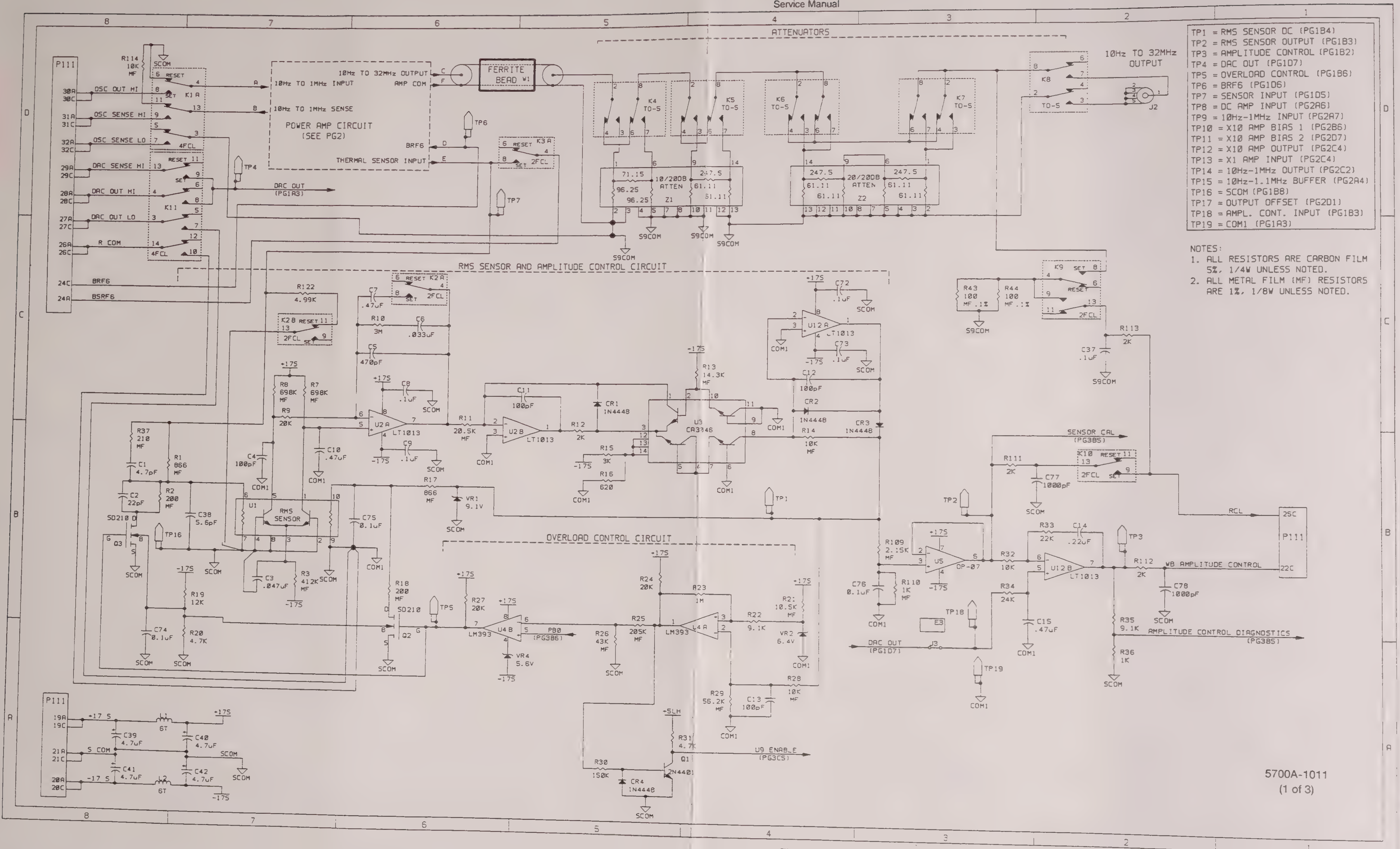


Figure 7-5. A5 Wideband Output PCA (Option -03)



TP1 = RMS SENSOR DC (PG1B4)
TP2 = RMS SENSOR OUTPUT (PG1B3)
TP3 = AMPLITUDE CONTROL (PG1B2)
TP4 = DAC OUT (PG1D7)
TP5 = OVERLOAD CONTROL (PG1B6)
TP6 = BRF6 (PG1D6)
TP7 = SENSOR INPUT (PG1D5)
TP8 = DC AMP INPUT (PG2A6)
TP9 = 10Hz-1MHz INPUT (PG2A7)
TP10 = X10 AMP BIAS 1 (PG2B6)
TP11 = X10 AMP BIAS 2 (PG2D7)
TP12 = X10 AMP OUTPUT (PG2C4)
TP13 = X1 AMP INPUT (PG2C4)
TP14 = 10Hz-1MHz OUTPUT (PG2C2)
TP15 = 10Hz-1.1MHz BUFFER (PG2A4)
TP16 = SCOM (PG1B8)
TP17 = OUTPUT OFFSET (PG2D1)
TP18 = AMPL. CONT. INPUT (PG1B3)
TP19 = COM1 (PG1A3)

NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

Figure 7-5. A5 Wideband Output PCA (Option -03) (cont)

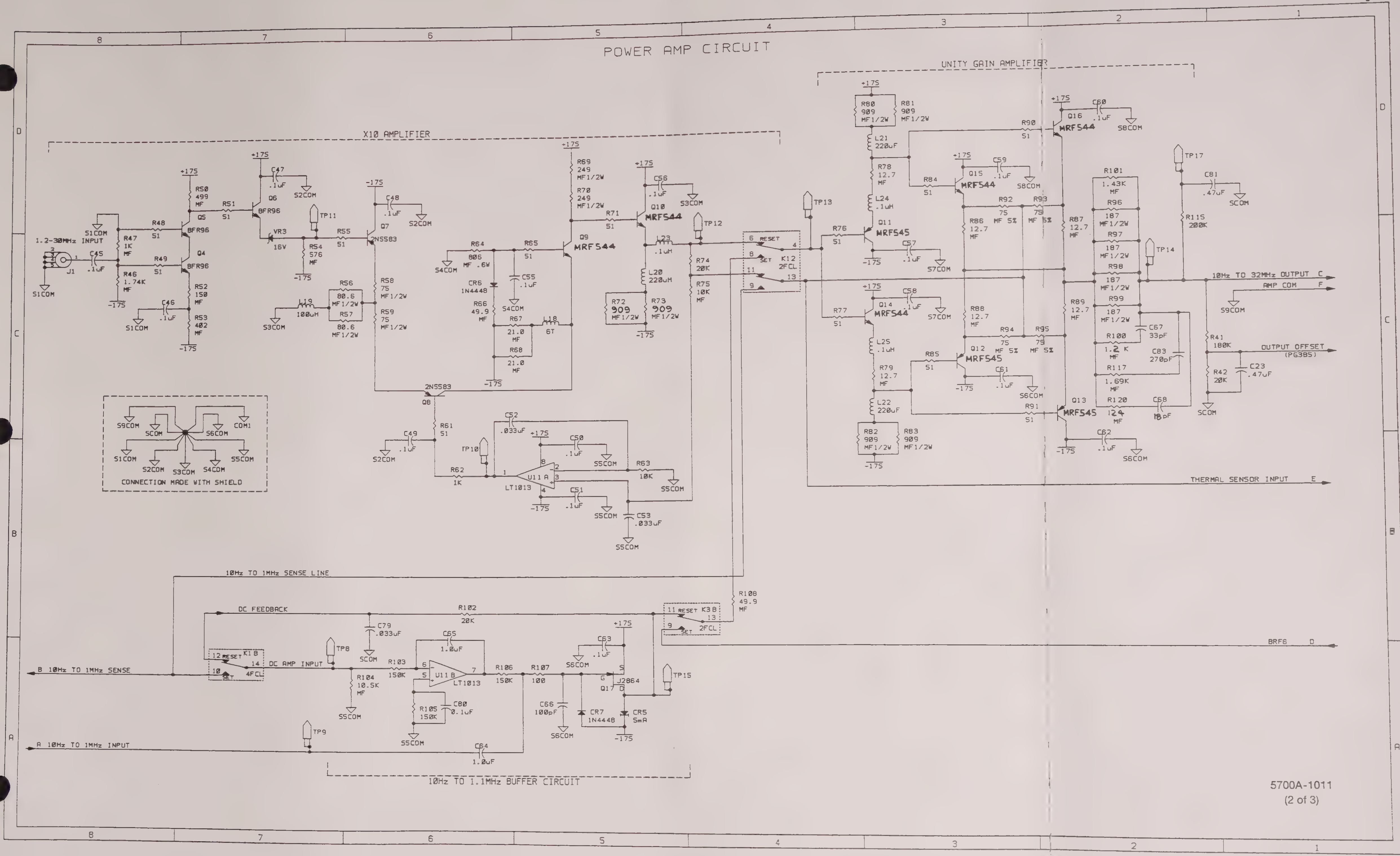
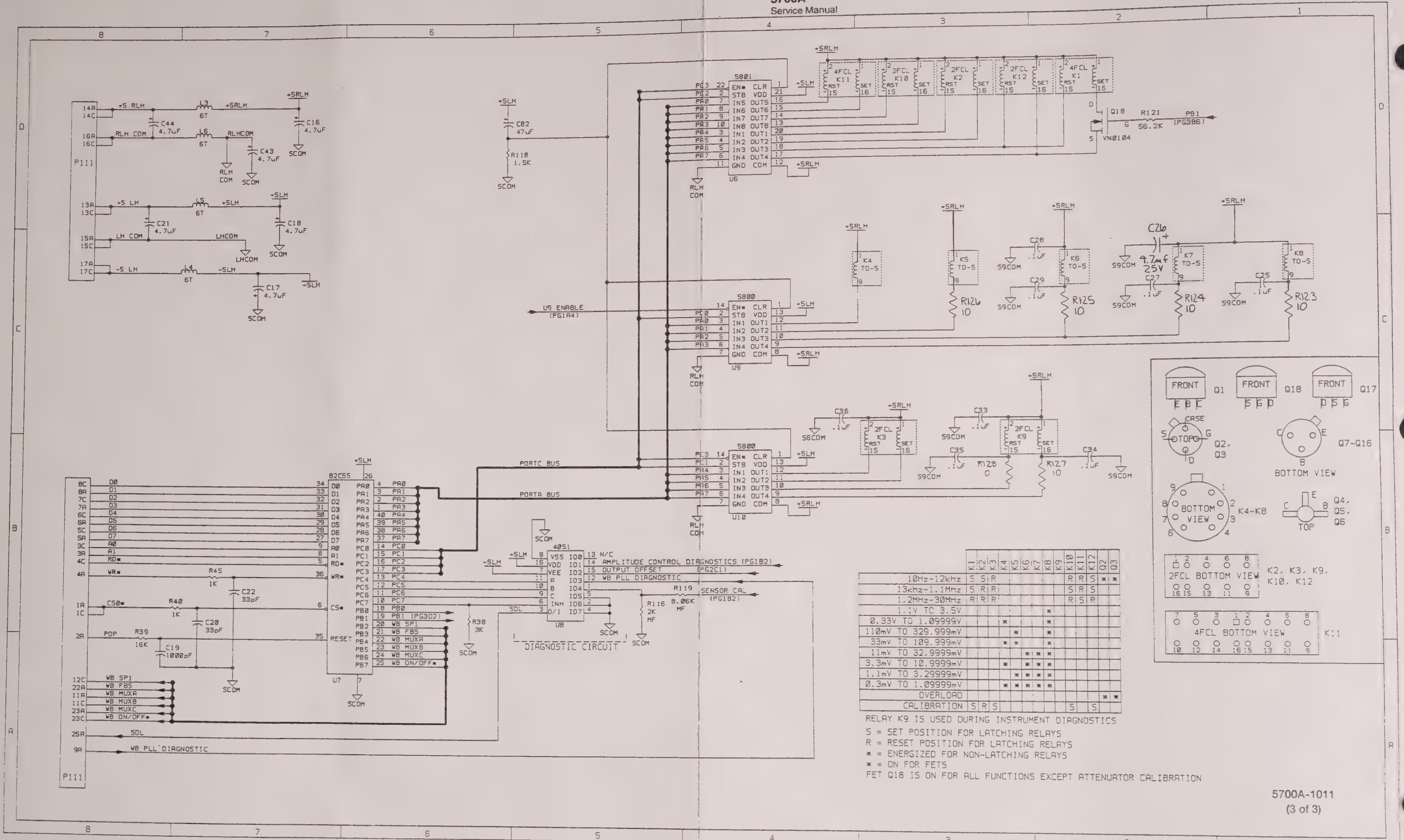


Figure 7-5. A5 Wideband Output PCA (Option -03) (cont)



	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	Q2	Q3
10Hz-12kHz	S	S	R							R	R	S	✱	✱
13kHz-1.1MHz	S	R	R							S	R	S		
1.2MHz-30MHz	R	R	R							R	S	R		
1.1V TO 3.5V								✱						
0.33V TO 1.09999V				✱				✱						
110mV TO 329.999mV					✱			✱						
33mV TO 109.999mV				✱	✱			✱						
11mV TO 32.9999mV						✱	✱	✱						
3.3mV TO 10.9999mV				✱		✱	✱	✱						
1.1mV TO 3.29999mV					✱	✱	✱	✱						
0.3mV TO 1.09999mV				✱	✱	✱	✱	✱						
OVERLOAD													✱	✱
CALIBRATION	S	R	S							S		S		

RELAY K9 IS USED DURING INSTRUMENT DIAGNOSTICS

S = SET POSITION FOR LATCHING RELAYS
R = RESET POSITION FOR LATCHING RELAYS
✱ = ENERGIZED FOR NON-LATCHING RELAYS
✱ = ON FOR FETS
FET Q18 IS ON FOR ALL FUNCTIONS EXCEPT ATTENUATOR CALIBRATION

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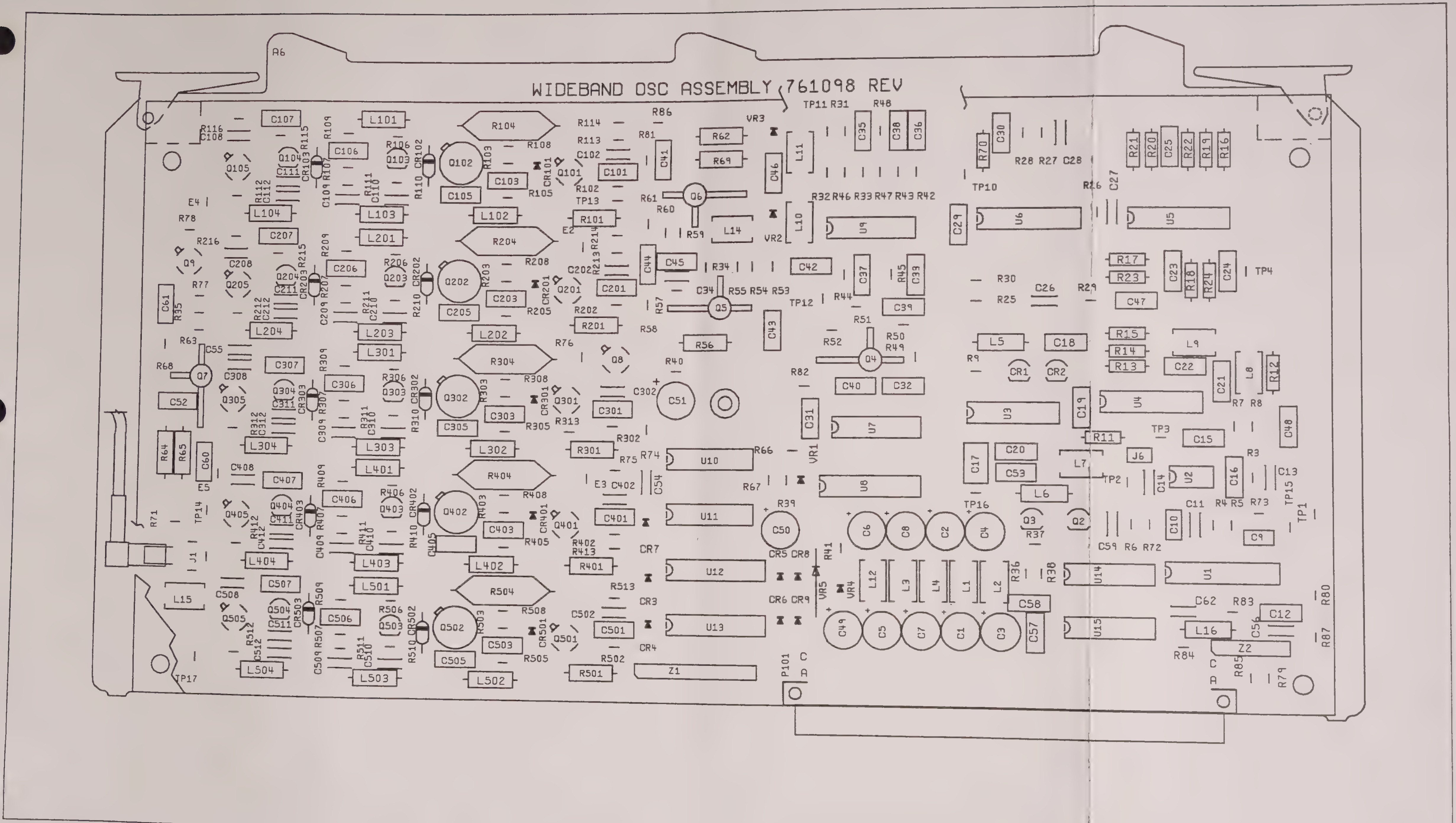
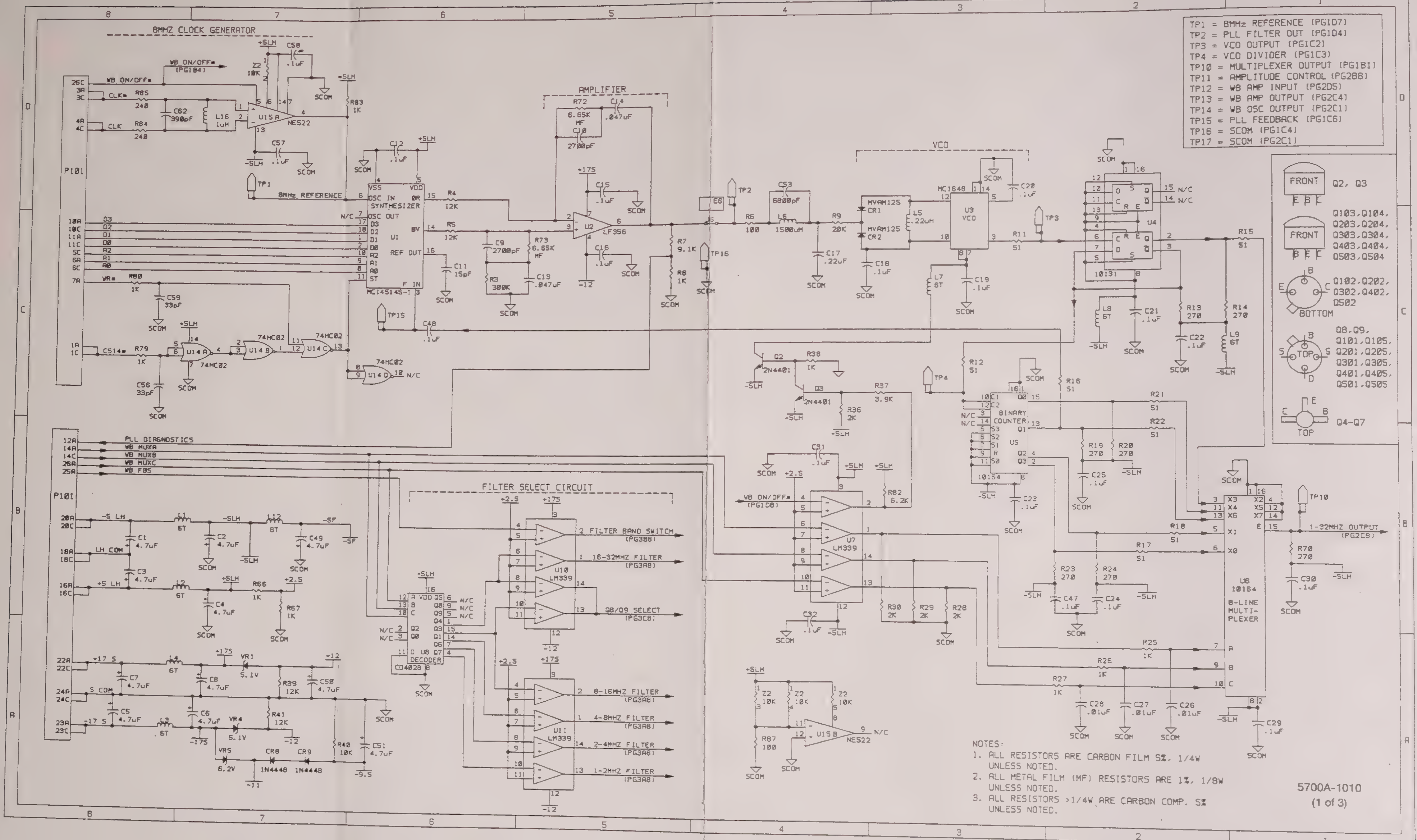
Figure 7-5. A5 Wideband Output PCA (Option -03) (cont)



5700A-1610

Figure 7-6. A6 Wideband Oscillator PCA (Option -03)


8MHZ CLOCK GENERATOR
AMPLIFIER
VCO
FILTER SELECT CIRCUIT
TP1 = 8MHz REFERENCE (PG1D7)
TP2 = PLL FILTER OUT (PG1D4)
TP3 = VCO OUTPUT (PG1C2)
TP4 = VCO DIVIDER (PG1C3)
TP10 = MULTIPLEXER OUTPUT (PG1B1)
TP11 = AMPLITUDE CONTROL (PG2B8)
TP12 = WB AMP INPUT (PG2D5)
TP13 = WB AMP OUTPUT (PG2C4)
TP14 = WB OSC OUTPUT (PG2C1)
TP15 = PLL FEEDBACK (PG1C6)
TP16 = SCOM (PG1C4)
TP17 = SCOM (PG2C1)
P101
WB ON/OFF*
(PG1B4)
U15A NE522
U1 MC145145-1 SYNTHESIZER
8MHz REFERENCE
U2 LF356
U3 VCO MC1648
MVAM125 CR1
MVAM125 CR2
U4 10131
U5 BINARY COUNTER 10154
U6 10164 8-LINE MULTI-PLEXER
U7 LM339
U10 LM339
U11 LM339
U8 DECODER CD4028
U14 74HC02
Q2 2N4401
Q3 2N4401
PLL DIAGNOSTICS
WB MUXA
WB MUXB
WB MUXC
WB FBS
2 FILTER BAND SWITCH (PG3B8)
1 16-32MHZ FILTER (PG3A8)
Q8/Q9 SELECT (PG3C8)
8-16MHZ FILTER (PG3A8)
4-8MHZ FILTER (PG3A8)
2-4MHZ FILTER (PG3A8)
1-2MHZ FILTER (PG3A8)
1-32MHZ OUTPUT (PG2C8)
FRONT Q2, Q3
FRONT Q103, Q104, Q203, Q204, Q303, Q304, Q403, Q404, Q503, Q504
BOTTOM Q102, Q202, Q302, Q402, Q502
TOP Q8, Q9, Q101, Q105, Q201, Q205, Q301, Q305, Q401, Q405, Q501, Q505
TOP Q4-Q7

NOTES:

1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.
3. ALL RESISTORS >1/4W ARE CARBON COMP. 5% UNLESS NOTED.

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Figure 7-6. A6 Wideband Oscillator PCA (Option -03)

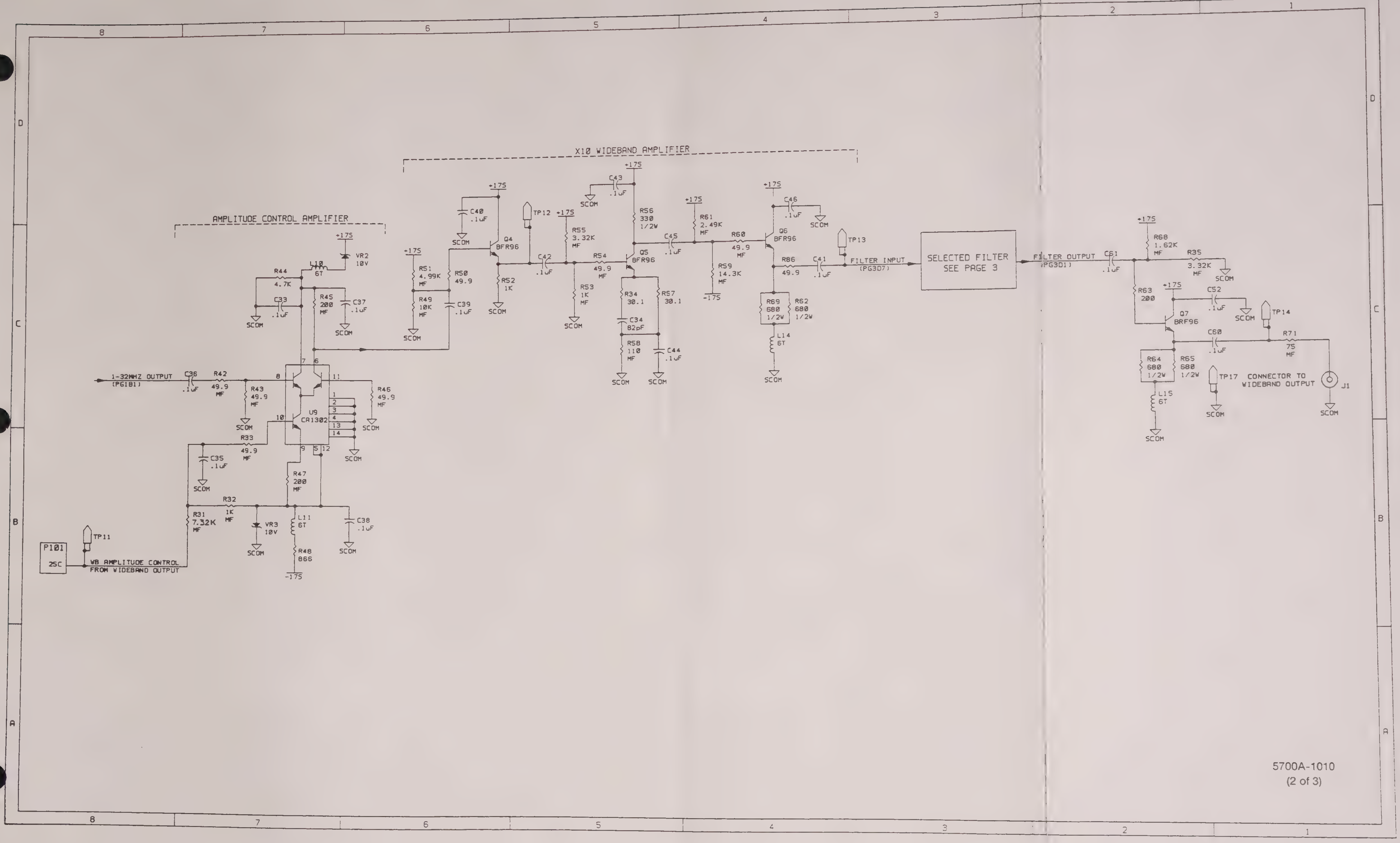


Figure 7-6. A6 Wideband Oscillator PCA (Option -03) (cont)

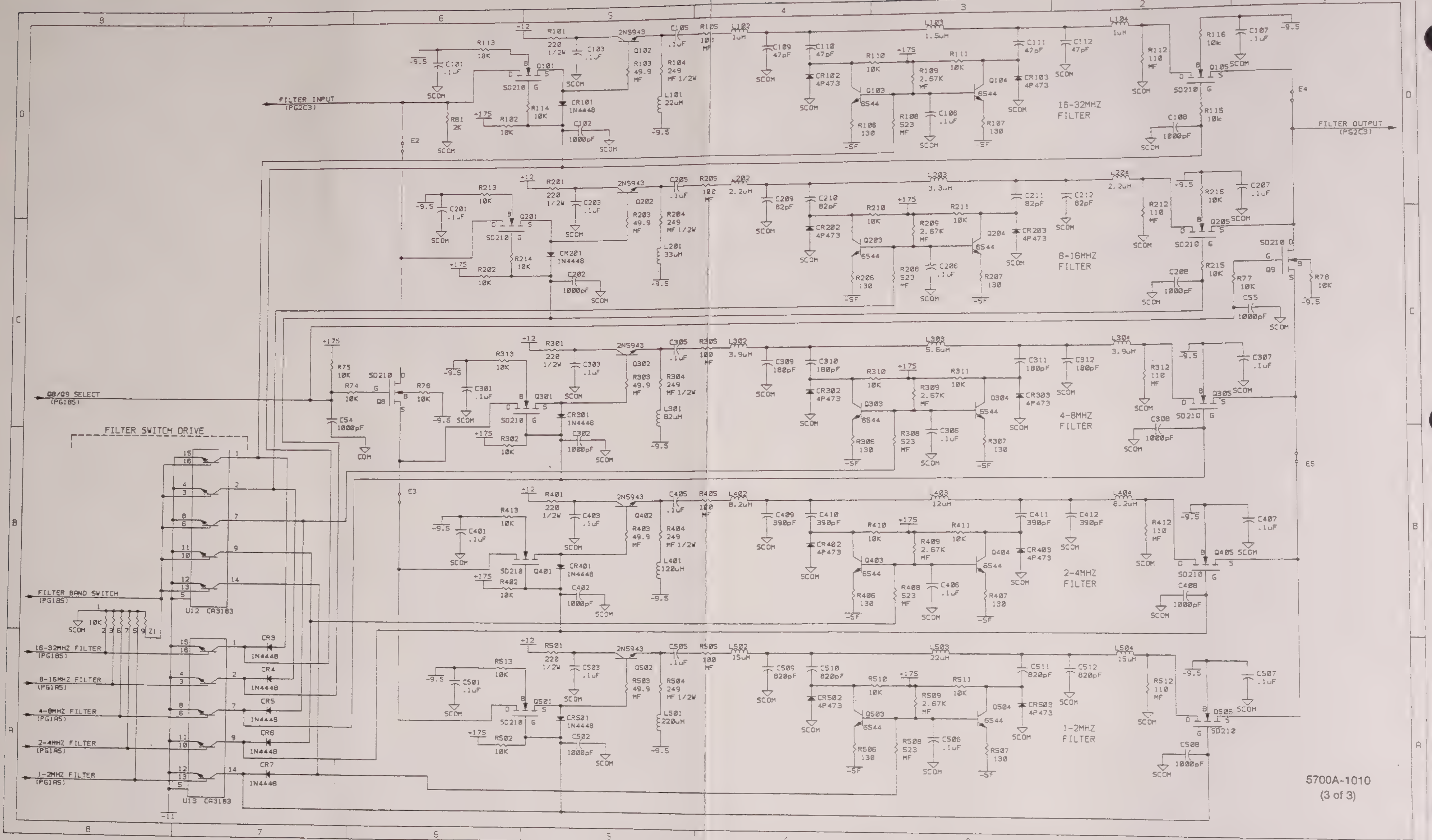


Figure 7-6. A6 Wideband Oscillator PCA (Option -03) (cont)

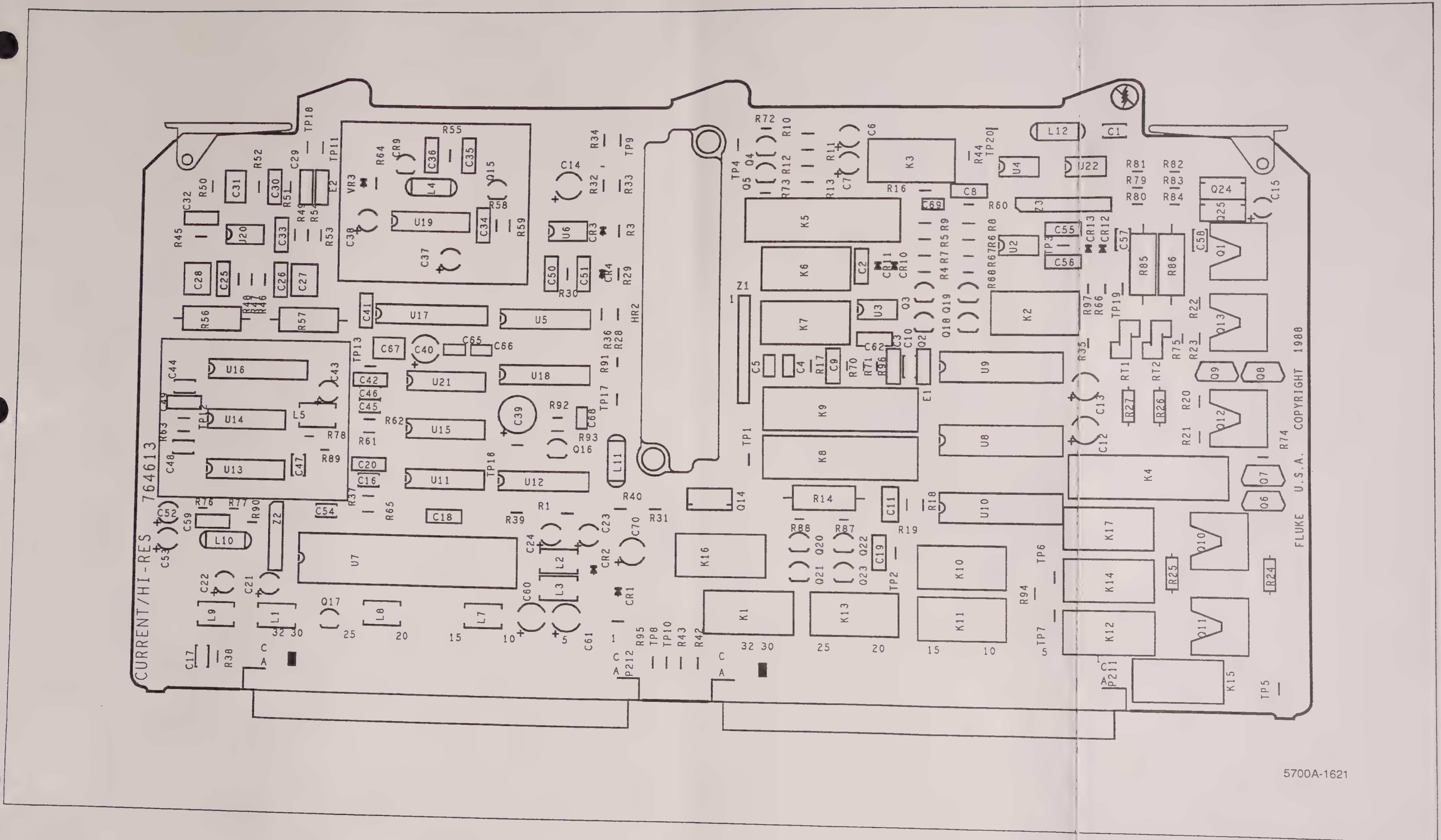
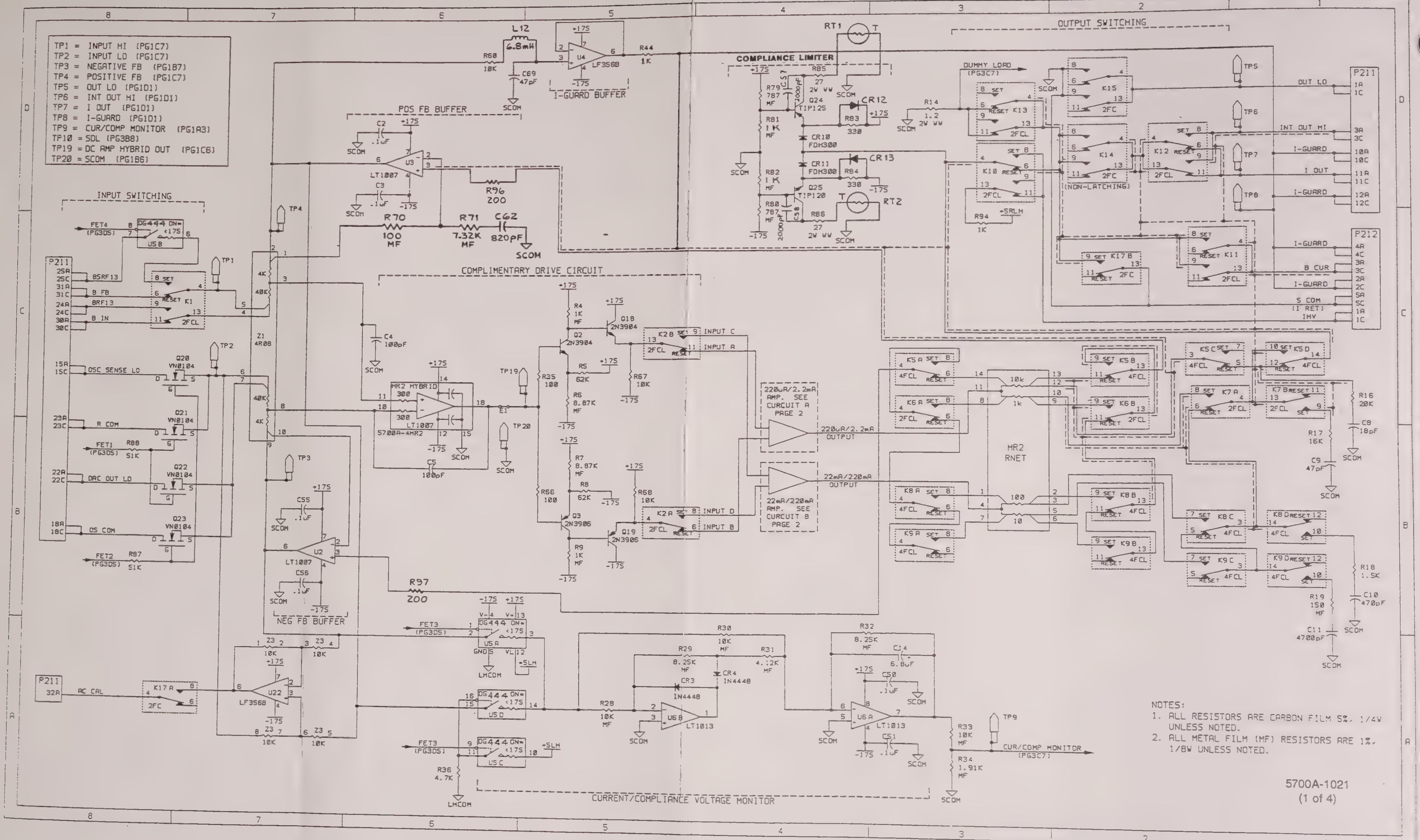

CURRENT/HI-RES
764613
FLUKE U.S.A. COPYRIGHT 1988
U1 U2 U3 U4 U5 U6 U7 U8 U9 U10 U11 U12 U13 U14 U15 U16 U17 U18 U19 U20 U21 U22
K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 K11 K12 K13 K14 K15 K16 K17
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25
L1 L2 L3 L4 L5 L7 L8 L9 L10 L11 L12
Z1 Z2 Z3
VR3
CR1 CR2 CR3 CR4 CR9 CR10 CR11 CR12 CR13
RT1 RT2
E1 E2
HR2
TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP13 TP14 TP16 TP17 TP18 TP19 TP20
P211 P212
C A
32 30 25 20 15 10 5 1
5700A-1621

Figure 7-7. A7 Current/High-Resolution Oscillator PCA



NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

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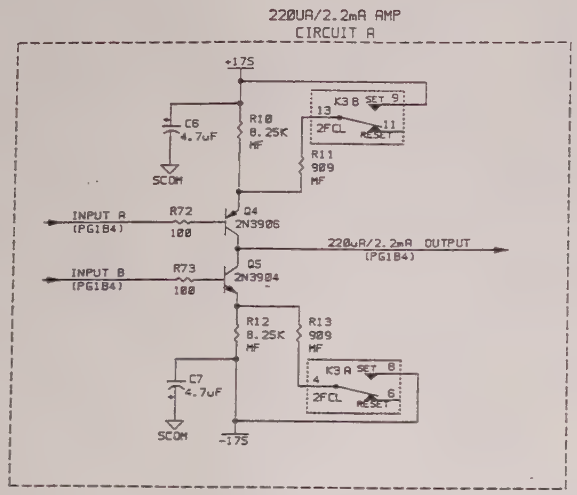
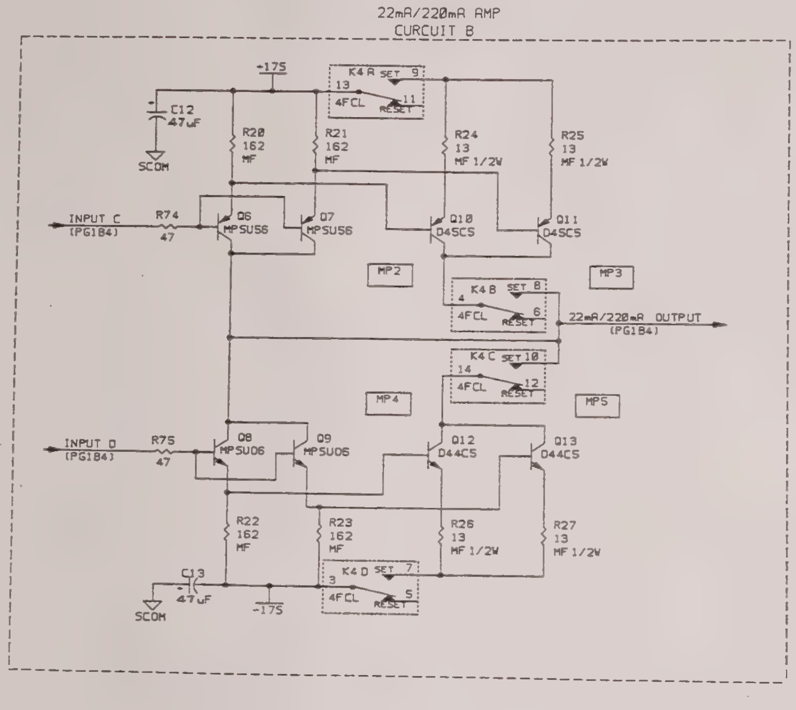
Figure 7-7. A7 Current/High-Resolution Oscillator PCA (cont)

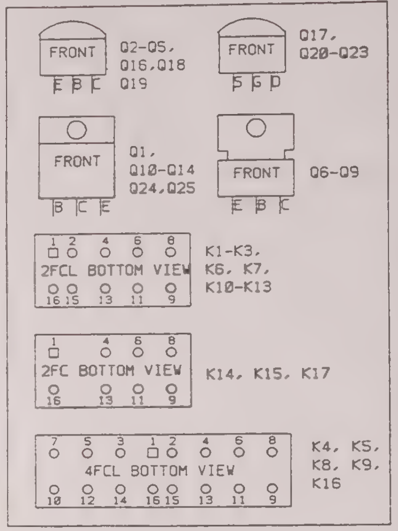


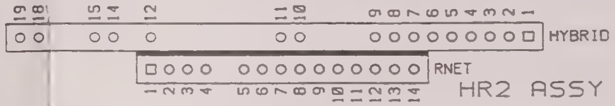


	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	Q20/Q23	Q21/Q22	U5A/U5C	U5D
PWR-UP / RESET																					
DC 220uA RANGE														■	■				■		
DC 2.2mA RANGE			S		S	S	S							■	■				■		
DC 22mA RANGE		S			S			S						■	■				■		
DC 220mA RANGE		S		S	S				S					■	■				■		
DC 2.2A RANGE		S			S					S	S			■	■				■		
AC 220uA RANGE														■	■			■			
AC 2.2mA RANGE			S		S	S	S							■	■			■			
AC 22mA RANGE		S			S			S						■	■			■			
AC 220mA RANGE		S		S	S				S					■	■			■			
AC 2.2A RANGE		S			S					S	S			■	■			■			

ALL RELAYS SHOWN IN THE RESET OR NON-LATCHING POSITION
S = SET POSITION OF LATCHING RELAYS
■ = ENERGIZED FOR NON-LATCHING RELAYS
■ = ON FOR FETS
K1 IS SET DURING CURRENT GAIN CALIBRATION
K12 IS SET WHEN CURRENT OUTPUT IS AT THE OUT HI BINDING POST OR RESET WHEN CURRENT OUTPUT IS AT THE AUX I OUT BINDING POST
K13 CONNECTS A DUMMY LOAD TO THE OUTPUT CURRENT WHEN RESET. THIS IS DONE DURING DIAGNOSTICS AND CURRENT RANGE SWITCHING

K16 IS SET DURING BOOST AMPLIFIER CALIBRATION
K17 IS ENERGIZED DURING AC CURRENT FLATNESS CHARACTERIZATION





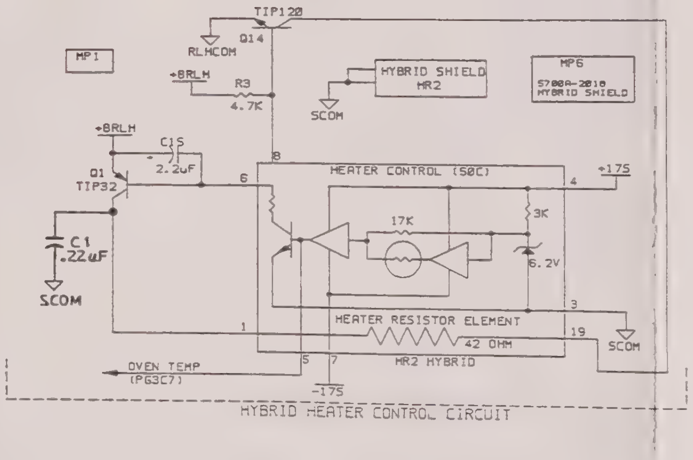


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Figure 7-7. A7 Current/High-Resolution Oscillator PCA (cont)

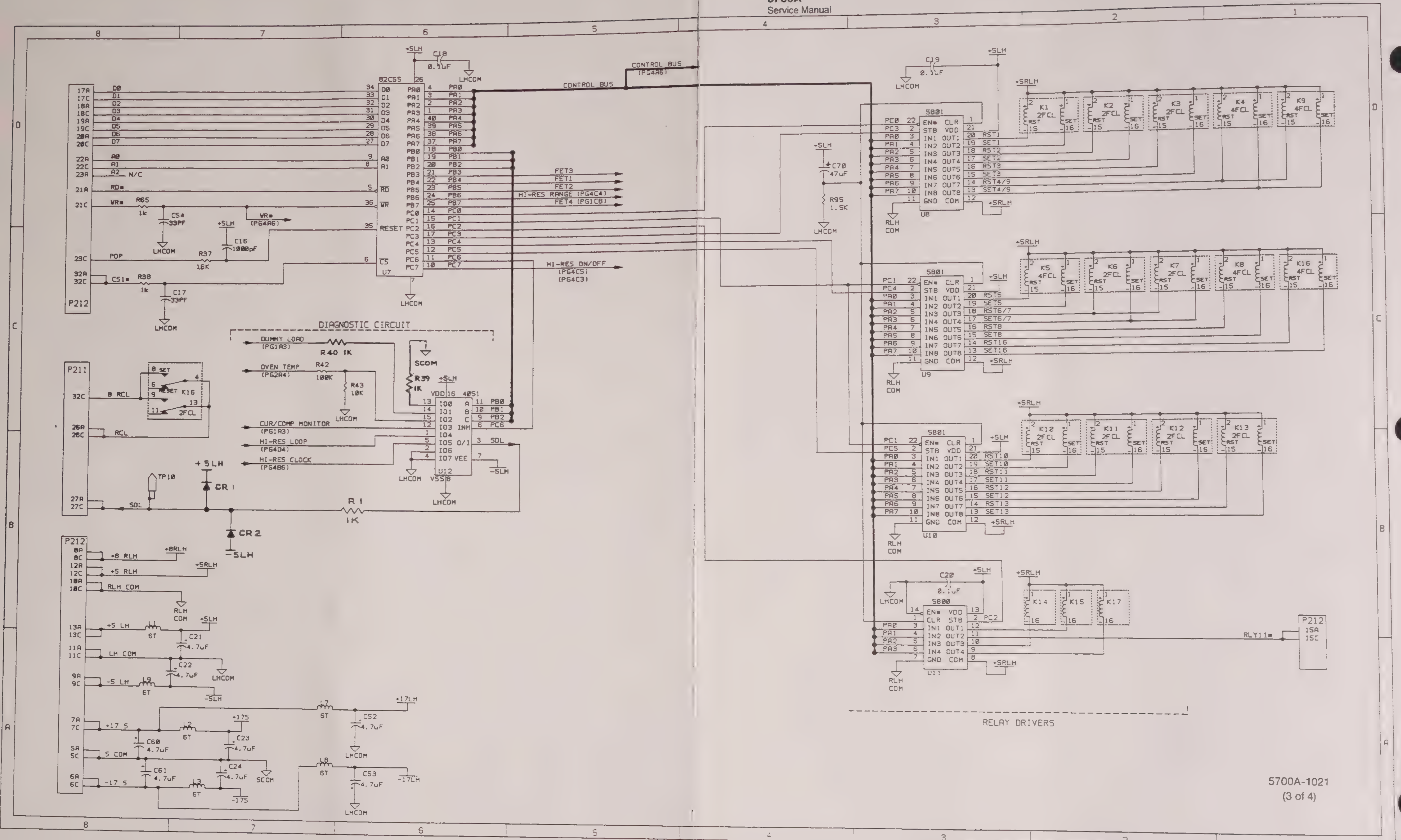


Figure 7-7. A7 Current/High-Resolution Oscillator PCA (cont)

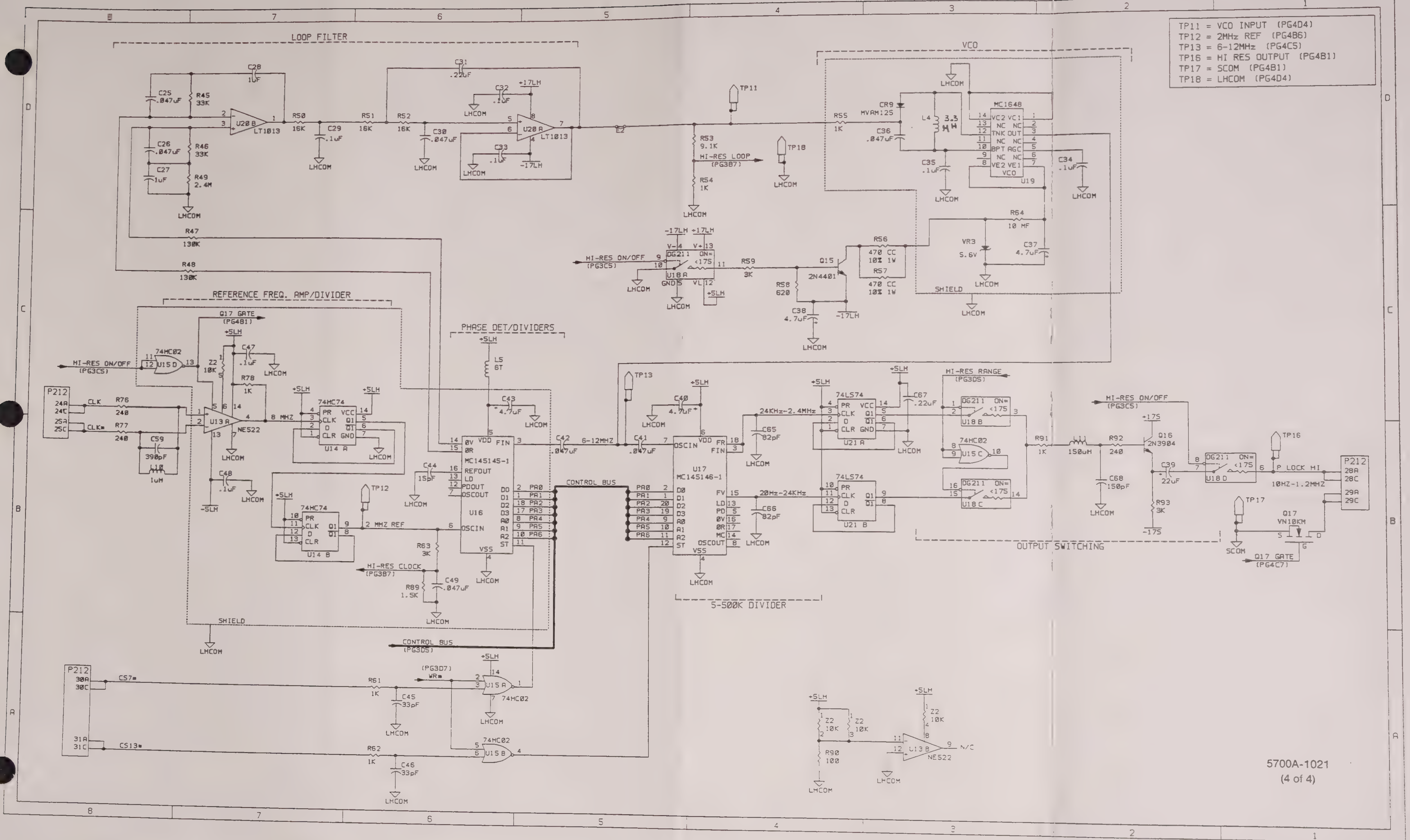
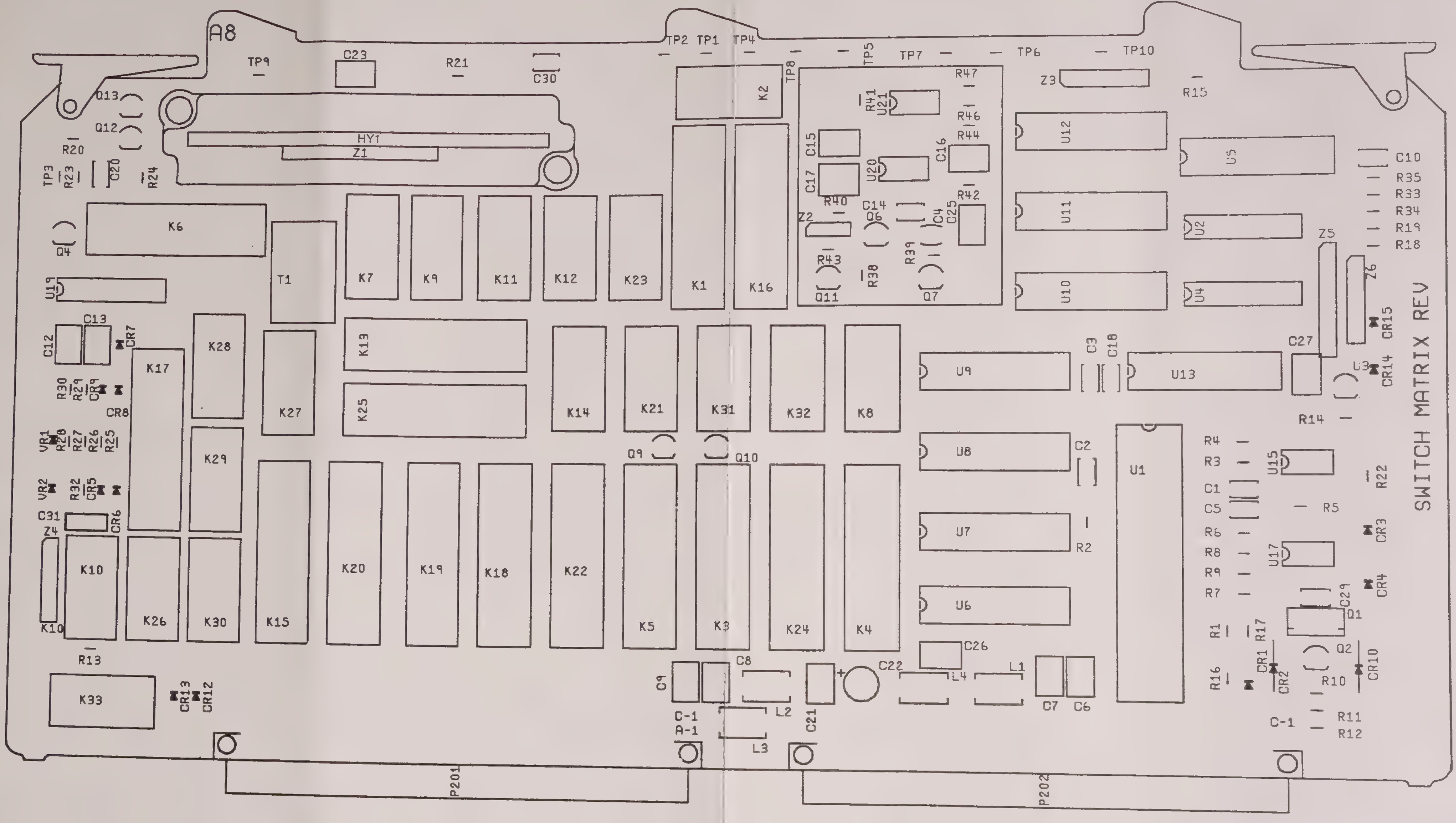
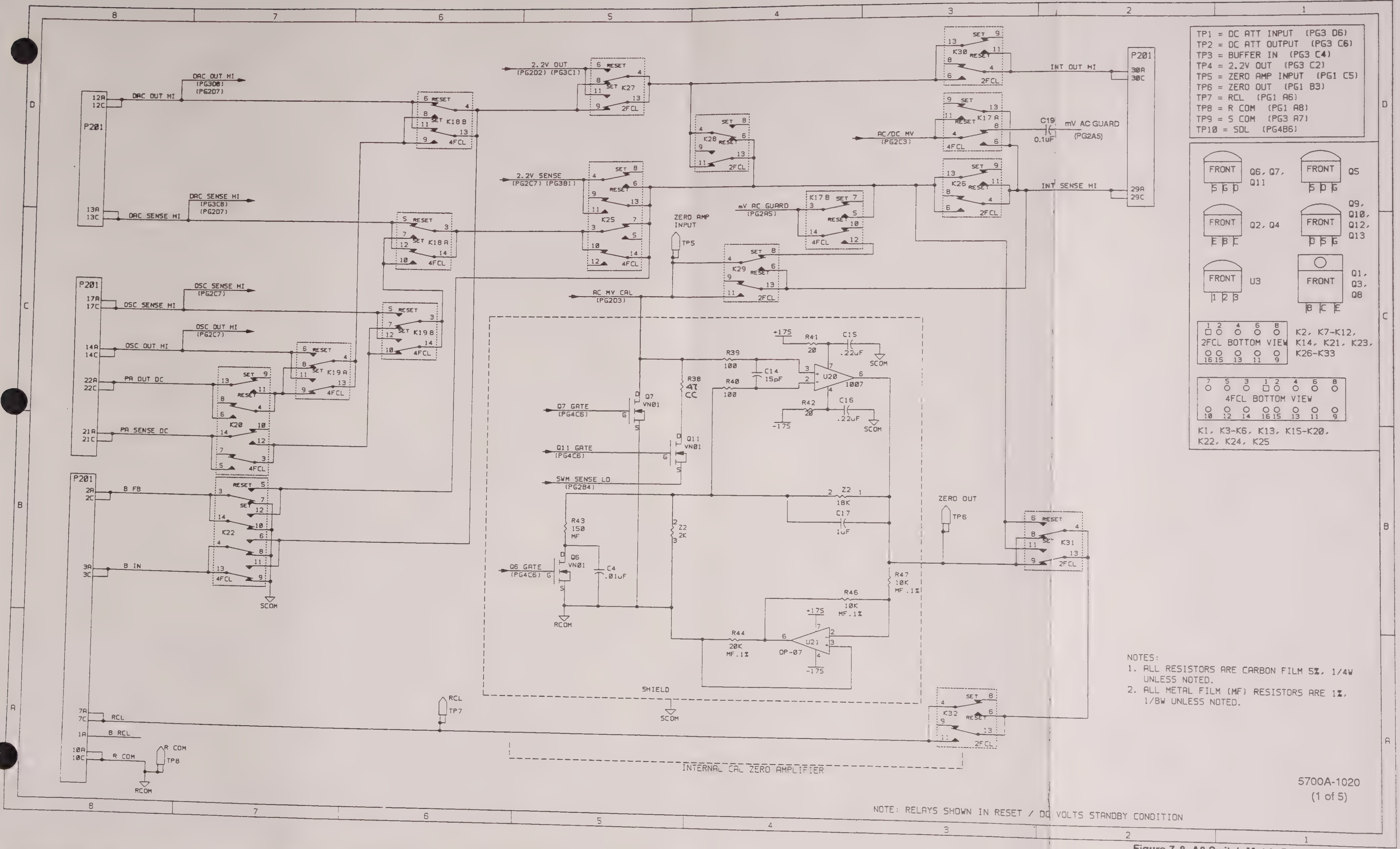


Figure 7-7. A7 Current/High-Resolution Oscillator PCA (cont)



5700A-1622

Figure 7-8. A8 Switch Matrix PCA



TP1 = DC ATT INPUT (PG3 D6)
TP2 = DC ATT OUTPUT (PG3 C6)
TP3 = BUFFER IN (PG3 C4)
TP4 = 2.2V OUT (PG3 C2)
TP5 = ZERO AMP INPUT (PG1 C5)
TP6 = ZERO OUT (PG1 B3)
TP7 = RCL (PG1 A6)
TP8 = R COM (PG1 A8)
TP9 = S COM (PG3 A7)
TP10 = SDL (PG4B6)

NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

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NOTE: RELAYS SHOWN IN RESET / DC VOLTS STANDBY CONDITION

Figure 7-8. A8 Switch Matrix PCA (cont)

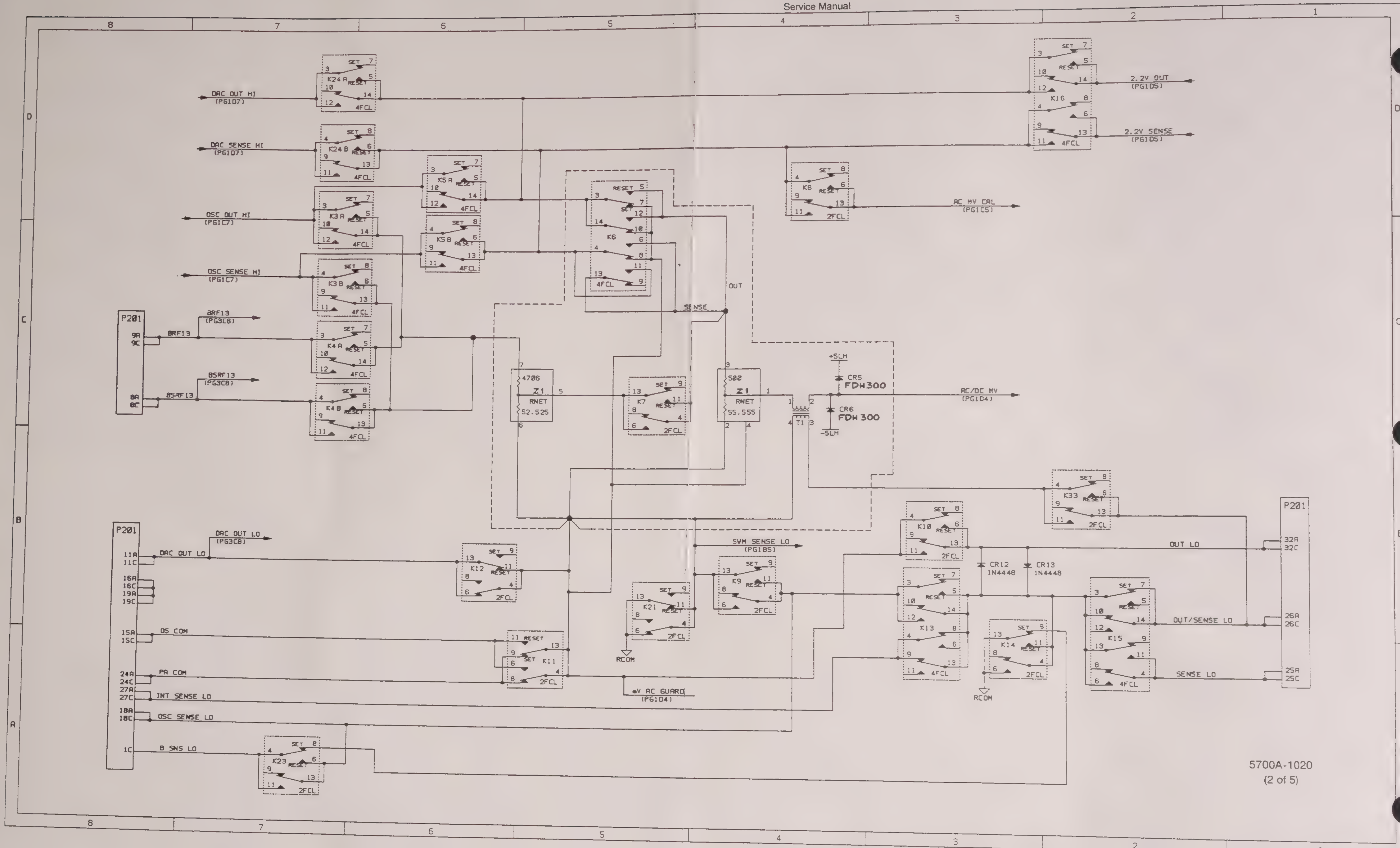

Figure 7-8. A8 Switch Matrix PCA (cont)

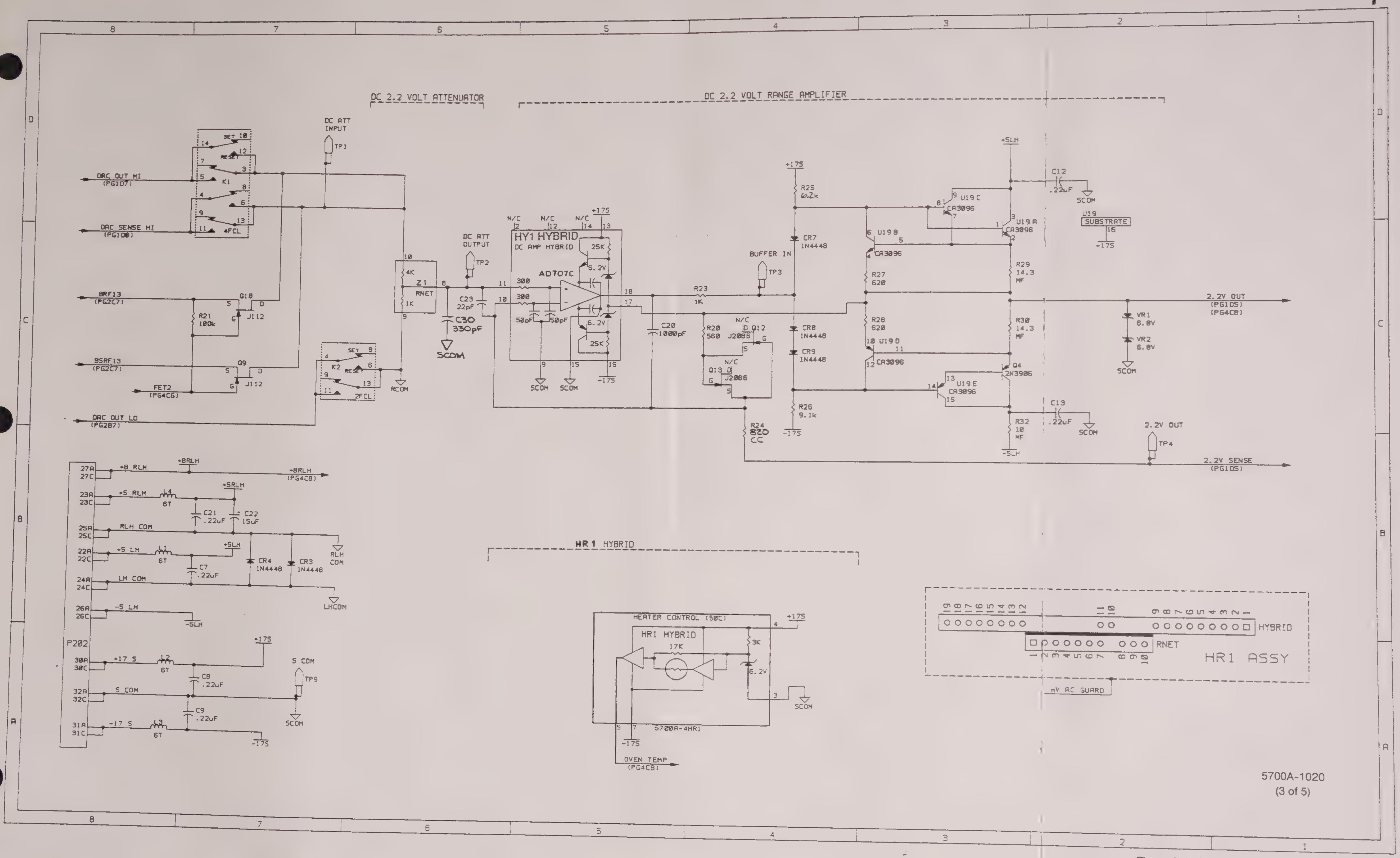

Figure 7-8. A8 Switch Matrix PCA (cont)

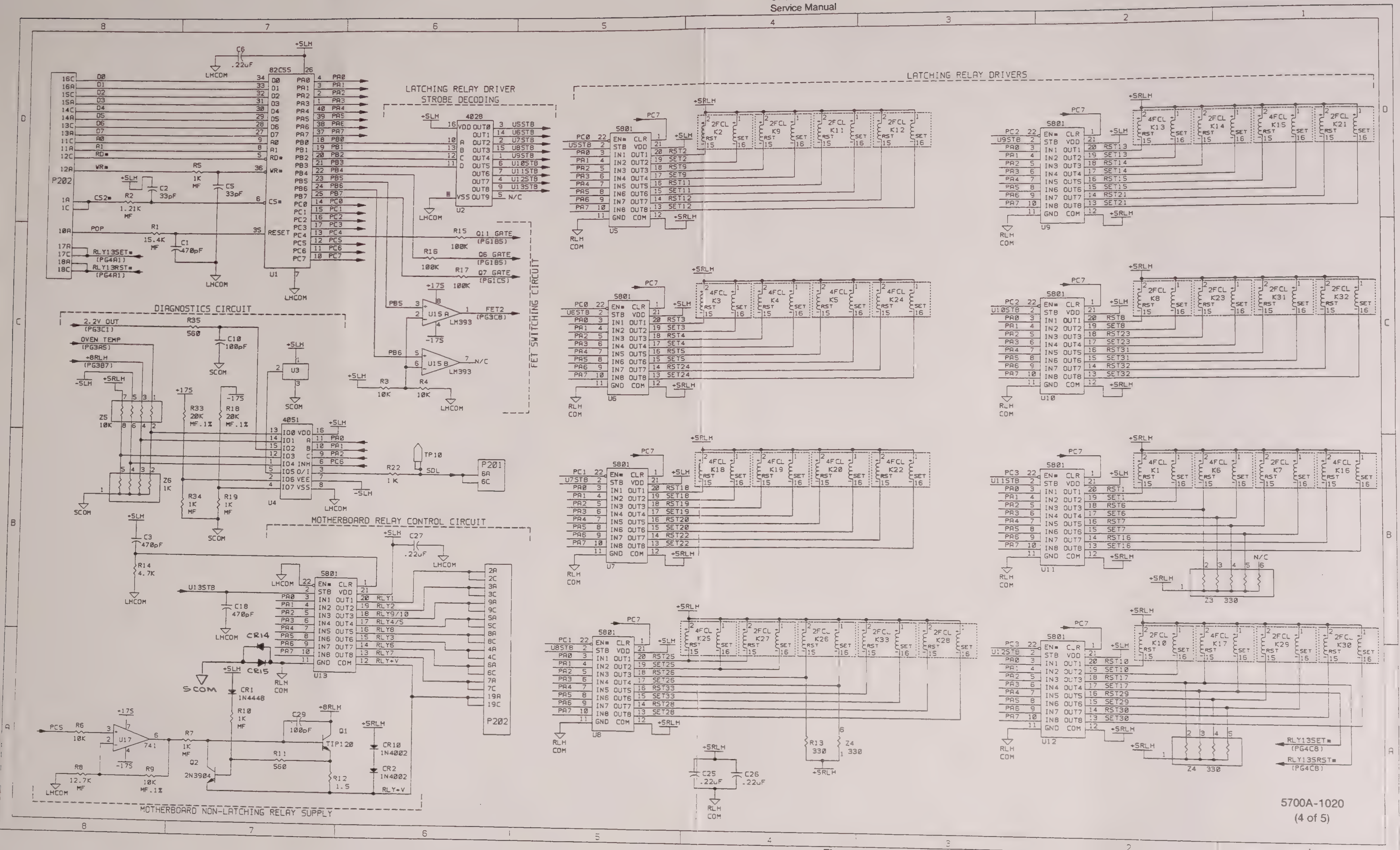

Figure 7-8. A8 Switch Matrix PCA (cont)

SWITCH MATRIX RELAYS AND FETS

MOTHERBOARD RELAYS

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24	K25	K26	K27	K28	K29	K30	K31	K32	K33	Q6	Q7	Q9/Q10	Q11	K1	K2	K3	K4/K5	K6	K7	K8	K9/K10	K13
RESET / DC VOLTS STANDBY												R						R			R							R							■											
DC 220mV RANGE	R	R				R										R	R				R												R						■			■	■	■		R
DC 2.2V RANGE	R	R								R				R	E										R	R	R			R					■			■	■	E		■	■	■		
DC 11V/22V RANGE										R		R		R	E			R								R				R					■			■	■	E		■	■	■		
DC 220V RANGE										R		R		R	E					R						R				R					■			■	■	E		■	■	■		
DC 1100V RANGE										R		R		R	E																				■					E		■	■	■	■	
DC 1100V 5205 MODE													R						R				R	R											■											
AC VOLTS STANDBY									R		R								R									R							■											
AC 2.2mV RANGE			R				R		R		R				R		R																R						■			■	■	■		R
AC 22mV RANGE			R				R		R		R				R		R																R						■			■	■	■		R
AC 220mV RANGE					R	R			R		R				R		R																R						■			■	■	■		R
AC 2.2V/22V RANGE										R	R		R		E				R							R				R					■			■	■	E		■	■	■		
AC 220V RANGE										R			R		E																				■					E		■	■	■	■	
AC 1100V RANGE										R			R		E																				■					E		■	■	■	■	

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24	K25	K26	K27	K28	K29	K30	K31	K32	K33	Q6	Q7	Q9/Q10	Q11	K1	K2	K3	K4/K5	K6	K7	K8	K9/K10	
AC 1100V BOOST MODE										R			R						R			R													■						■					
AC 1100V 5205 MODE												R		R				R				R	R		R		R								■											
BOOST DC CURRENT MODE	R	R										R										R			R		R	R							■											
BOOST AC CURRENT MODE									R										R			R	R												■											
DC 11V RANGE ZERO CAL												R						R			R					R		R	R			R		■												
CAL 10V DC TO EXT 10V STD										R		R		R												R					R	R			■				■							
2.2V RANGE OFFSET CAL	R	R										R													R	R	R	R	R			R		■												
2.2V RANGE GAIN CAL		R										R													R		R	R	R		R	R			■	■										
220mV RANGE CHECKPOINT	R	R				R										R					R											R		■			■									R
220mV RANGE OFFSET CAL	R	R				R										R	R				R								R			R		■												R
220mV RANGE GAIN CAL						R						R					R				R			R					R			R														R
22mV RANGE GAIN CAL				R		R	R	R				R						R			R							R				R														
	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24	K25	K26	K27	K28	K29	K30	K31	K32	K33	Q6	Q7	Q9/Q10	Q11	K1	K2	K3	K4/K5	K6	K7	K8	K9/K10	

R = RESET POSITION FOR ALL LATCHING RELAYS
■ = ENERGIZED FOR NON-LATCHING RELAYS
■ = ON FOR FETS
E = EXTERNAL SENSE STATE FOR K15 RESET AND MOTHERBOARD RELAY K3 ENERGIZED

THE SCHEMATIC IS SHOWN WITH THE RELAYS IN THE RESET / DC VOLTS STANDBY CONDITION

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Figure 7-8. A8 Switch Matrix PCA (cont)

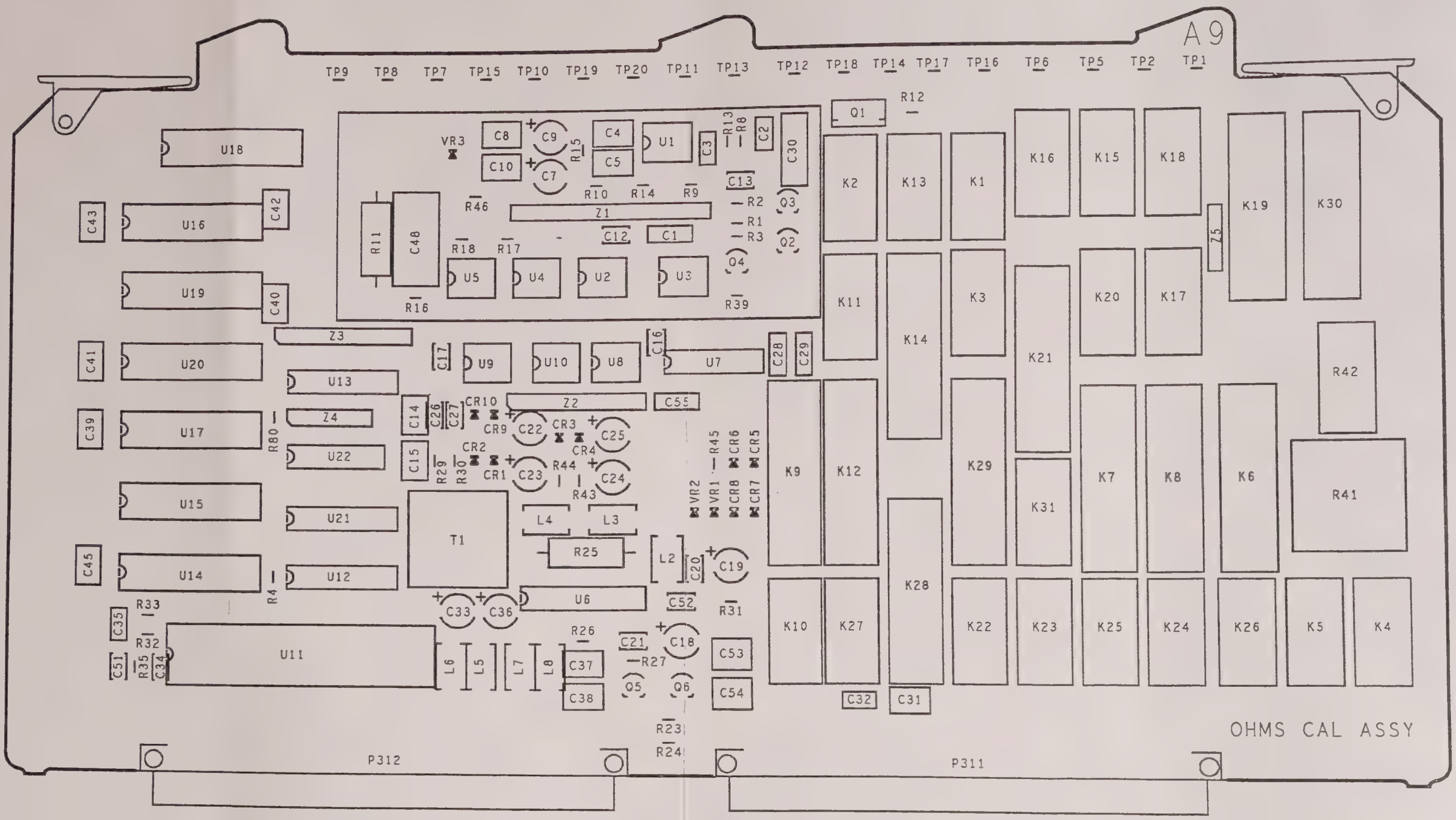
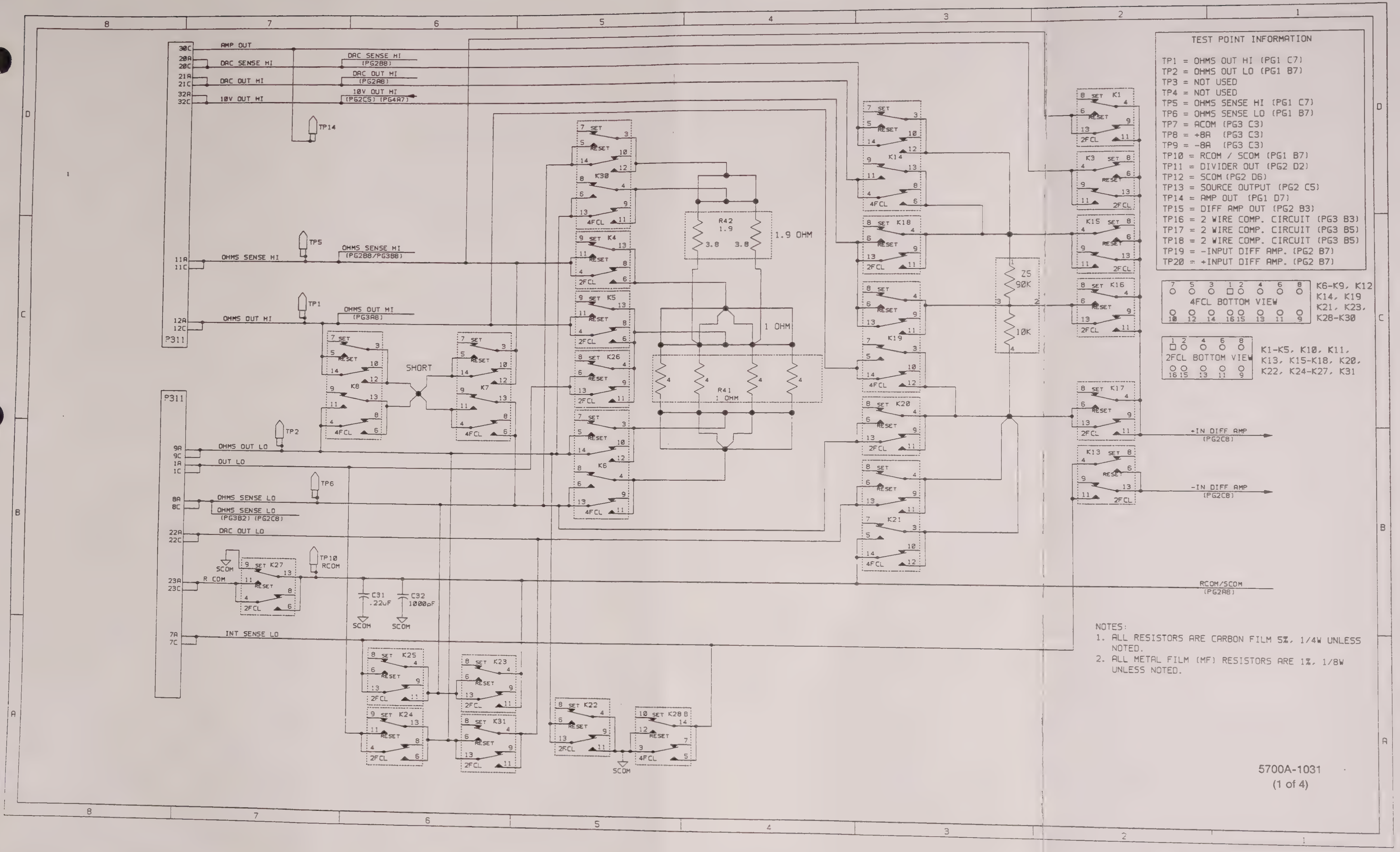


Figure 7-9 A9 Ohms Cal PCA



NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

Figure 7-9. A9 Ohms Cal PCA (cont)

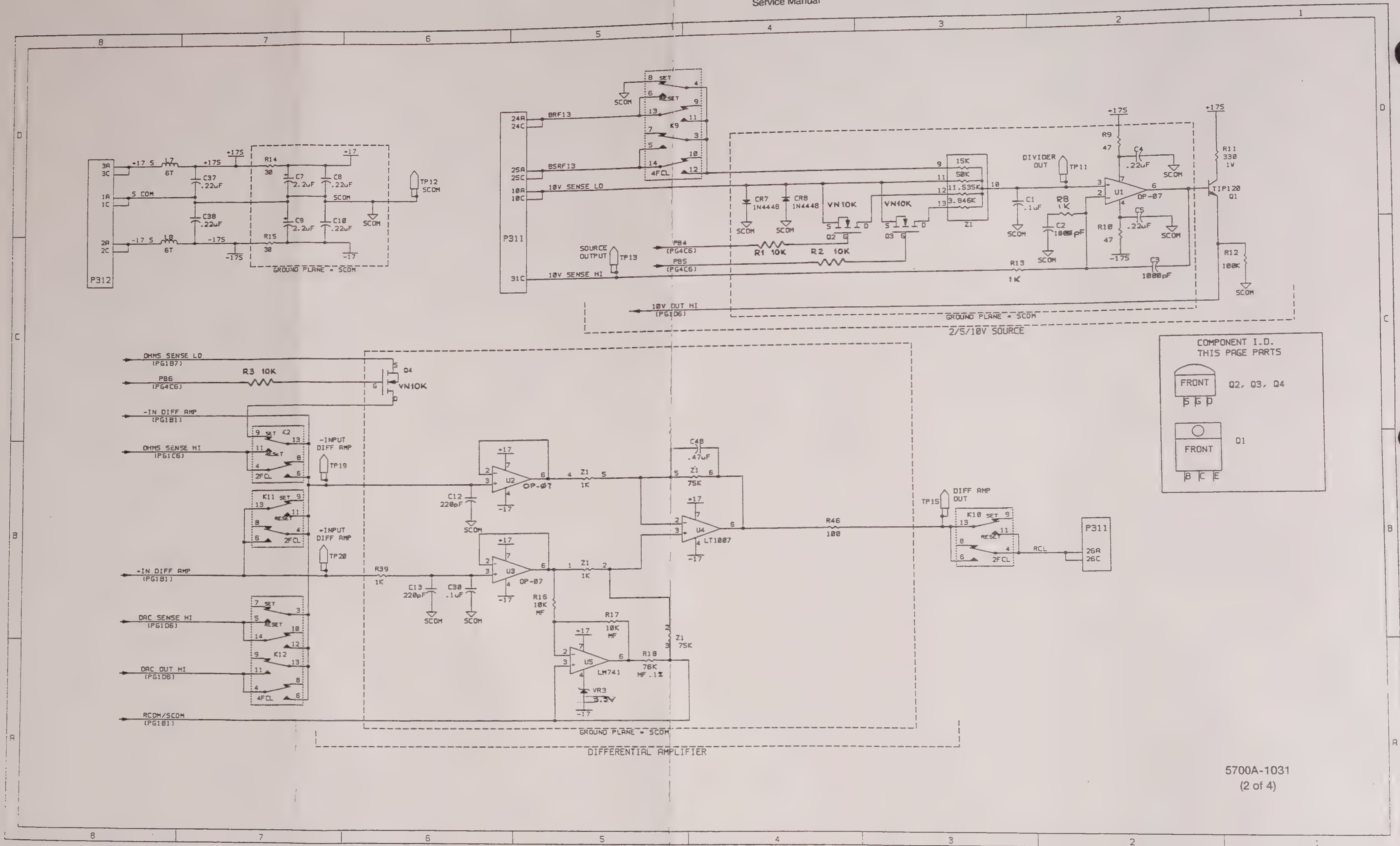


Figure 7-9. A9 Ohms Cal PCA (cont)

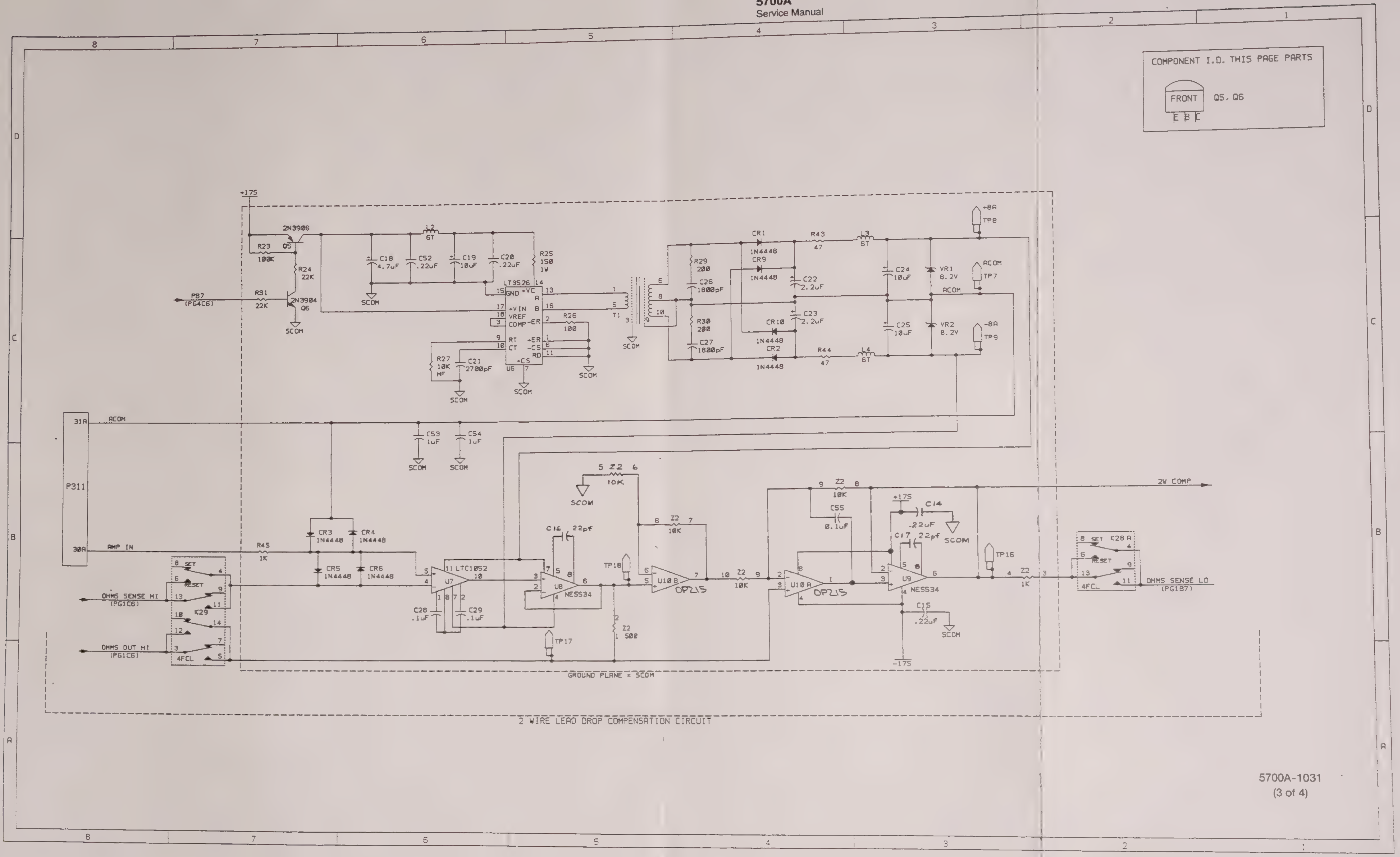


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Figure 7-9. A9 Ohms Cal PCA (cont)

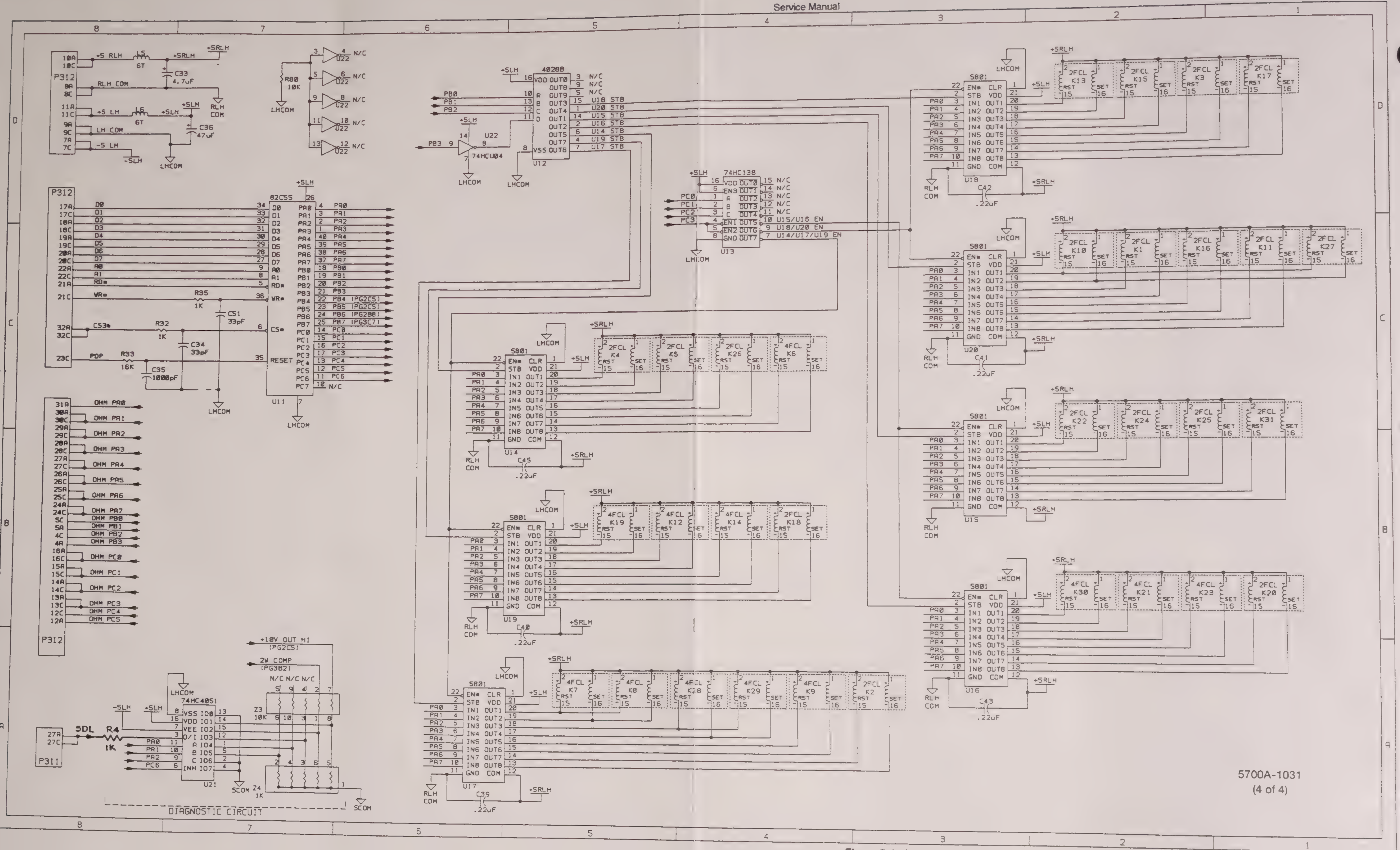


Figure 7-9. A9 Ohms Cal PCA (cont)

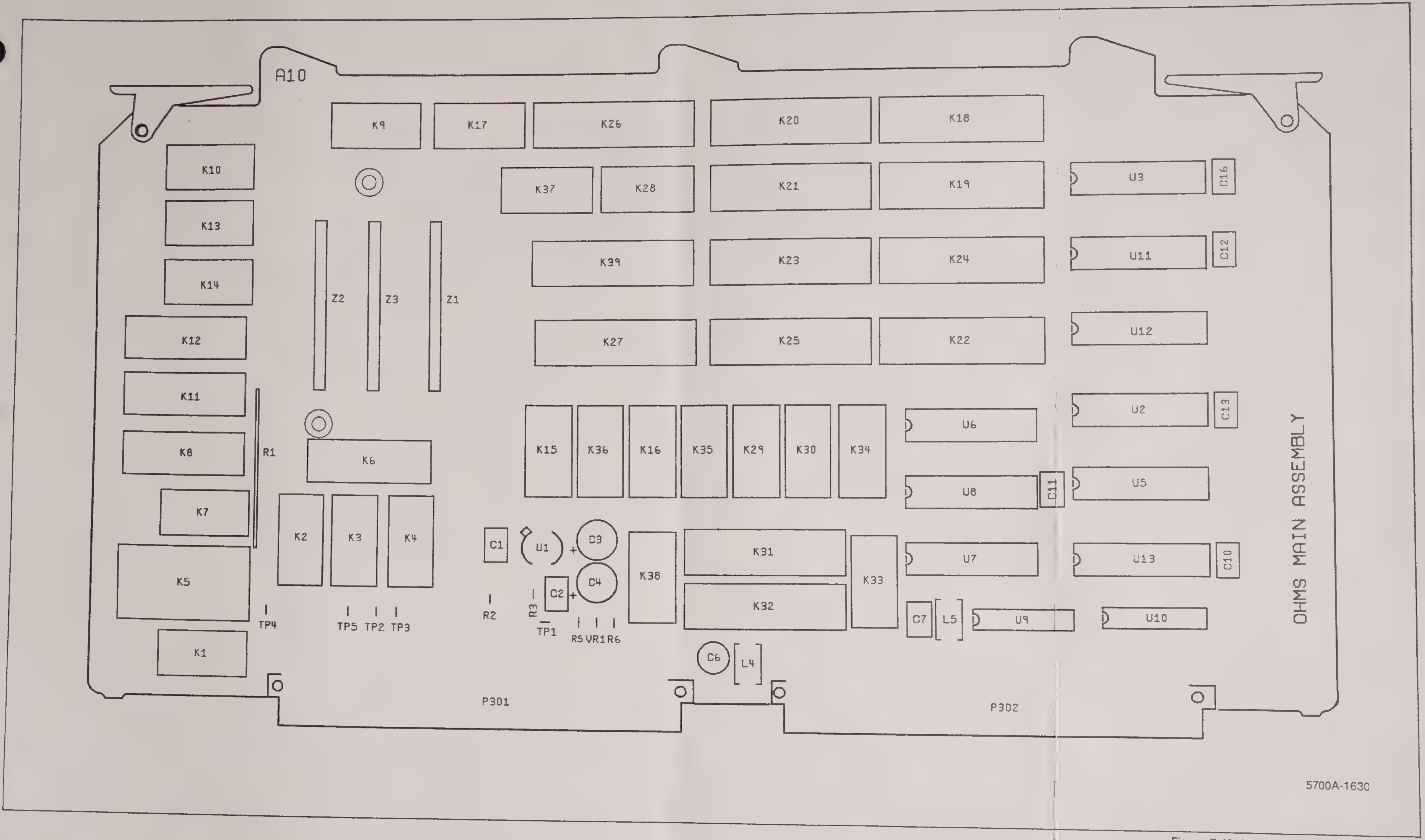
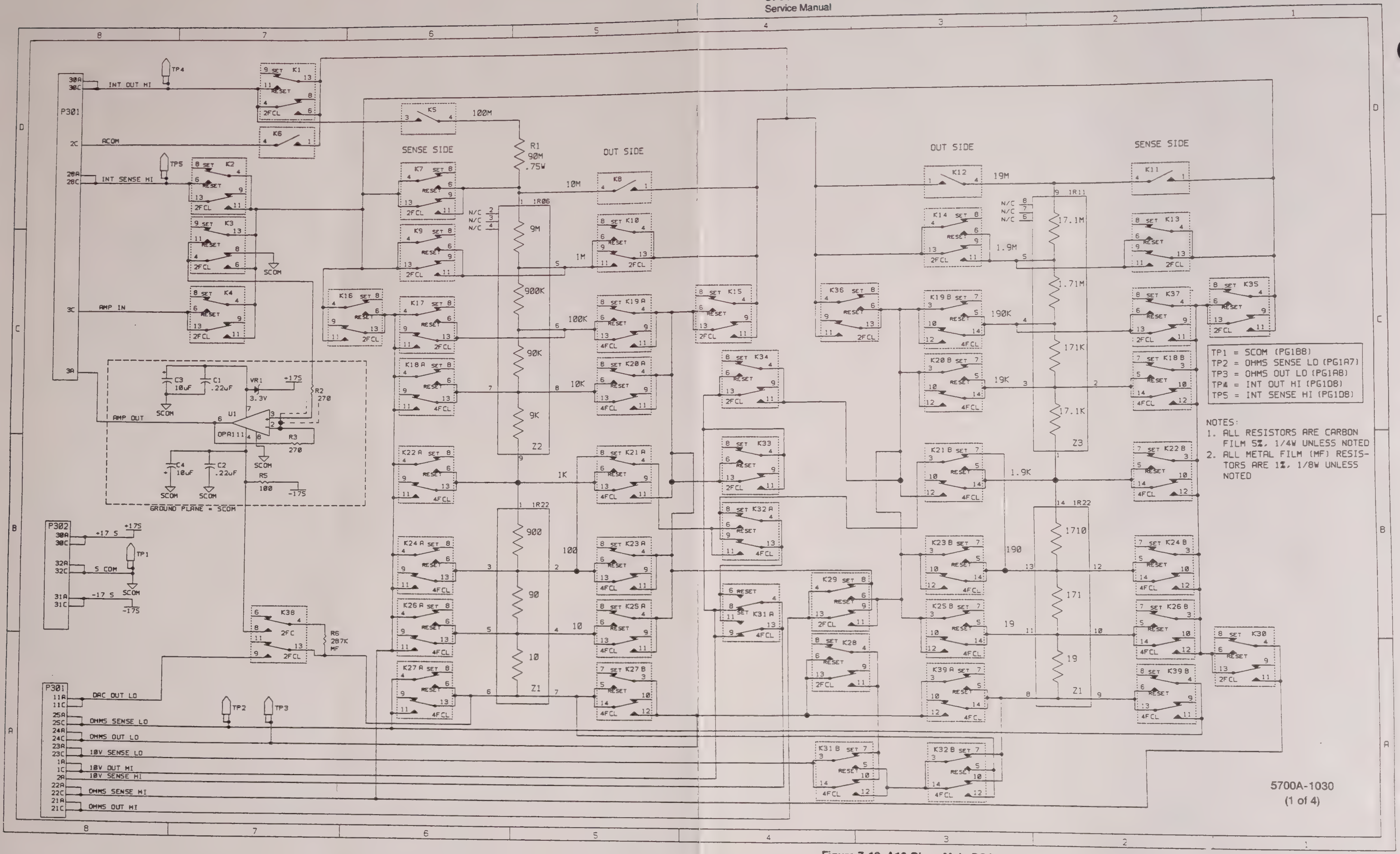


Figure 7-10. A10 Ohms Main PCA



TP1 = SCOM (PG1B8)
TP2 = OHMS SENSE LO (PG1A7)
TP3 = OHMS OUT LO (PG1A8)
TP4 = INT OUT HI (PG1D8)
TP5 = INT SENSE HI (PG1D8)

NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED

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Figure 7-10. A10 Ohms Main PCA (cont)

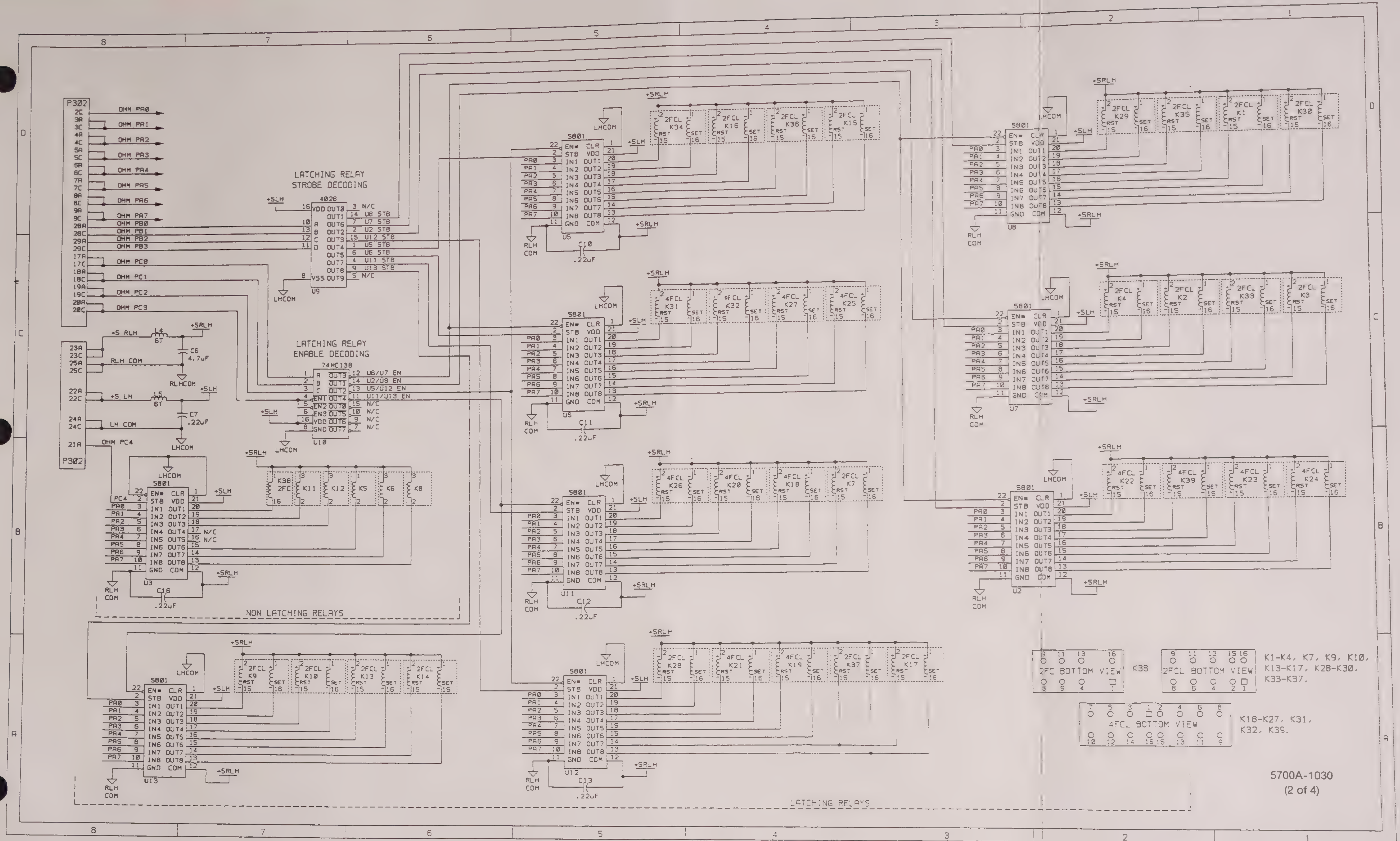

Figure 7-10. A10 Ohms Main PCA (cont)

OHMS MAIN ASSEMBLY RELAYS

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24	K25	K26	K27	K28	K29	K30	K31	K32	K33	K34	K35	K36	K37	K38	K39
DORMANT																																							
4 WIRE SHORT	R	R													R	R																							
4 WIRE 1 OHM	R	R													R	R																							
4 WIRE 1.9 OHM	R	R													R	R																							
4 WIRE 10 OHM	R	R													R	R									R	R	R												
4 WIRE 19 OHM	R	R																							R	R									R	R			R
4 WIRE 100 OHM	R	R													R	R							R	R			R												
4 WIRE 190 OHM	R	R																					R	R											R	R			R
4 WIRE 1K OHM	R	R													R	R					R	R					R												
4 WIRE 1.9K OHM	R	R																			R	R													R	R			R
4 WIRE 10K OHM	R	R													R	R		R		R							R												
4 WIRE 19K OHM	R	R																R		R															R	R			R
4 WIRE 100K OHM	R	R													R	R	R		R								R										R		
4 WIRE 190K OHM	R	R															R		R																R	R	R		R
4 WIRE 1M OHM	R	R							R	R																	R												
4 WIRE 1.9M OHM	R	R											R	R																									R
4 WIRE 10M OHM	R	R					R	■																			R												
4 WIRE 19M OHM	R	R									■	■																											R
2 WIRE 100M OHM					■																						R												
2 WIRE COMP. SHORT	R	R		R		■																																	
2 WIRE COMP. 1 OHM	R	R		R		■																																	
2 WIRE COMP. 1.9 OHM	R	R		R		■																																	
2 WIRE COMP. 10 OHM	R	R		R		■																			R	R	R												
2 WIRE COMP. 19 OHM	R	R		R		■																			R	R			R	R									R
2 WIRE COMP. 100 OHM	R	R		R		■																	R	R			R												
2 WIRE COMP. 190 OHM	R	R		R		■																	R	R					R	R									R
2 WIRE COMP. 1K OHM	R	R		R		■															R	R					R												
2 WIRE COMP. 1.9K OHM	R	R		R		■															R	R							R	R									R
2 WIRE COMP. 10K OHM	R	R		R		■												R		R							R												
2 WIRE COMP. 19K OHM	R	R		R		■												R		R									R	R									R
DIAG SOURCE10																											R	R											
DIAG SOURCES5																											R	R											
DIAG SOURCE2																											R	R											
DIAG DIFFAMP																											R	R											
DIAG DIVIDER1																											R	R											
DIAG DIVIDER2																											R	R											
DIAG 10K CAL																				R							R	R											
DIAG 19K CAL																				R								R	R										R
DIAG CHK 10K	R														R			R		R							R												
DIAG CHK 19K	R																	R		R										R						R			R
DIAG CHK 1K	R														R						R	R					R												
DIAG CHK 1.9K	R																				R	R								R						R			R
DIAG CHK 100	R														R								R	R			R												
DIAG CHK 190	R																						R	R						R						R			R
DIAG CHK 10	R														R										R	R	R												
DIAG CHK 19	R																								R	R				R						R			R
DIAG 10 CAL																							R			R	R				R	R	R						
DIAG 19 CAL																							R			R				R	R			R					R
DIAG RATIO 100K																		R	R								R	R					R						
DIAG RATIO 190K																		R	R									R		R				R					R
DIAG RATIO 1M			R							R					R	R	R										R	R					R				R		
DIAG RATIO 1.9M			R											R			R											R						R	R	R	R		R
DIAG RATIO 10M			R					■	R						R												R	R					R						
DIAG RATIO 19M1			R									■	R															R						R		R			R
DIAG RATIO 19M2			R								■	■																R						R		R			R
DIAG RATIO 100M	R		R		■		R								R												R	R					R						
DIAG CHK 1	R														R																								
DIAG CHK 1.9	R														R																								
DIAG CHK SHORT	R														R																								
DIAG 2W COMP	R			R		■							R	R											R	R	R												

OHMS CAL ASSEMBLY RELAYS AND FETS

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24	K25	K26	K27	K28	K29	K30	K31	Q2	Q3	Q4	Q6
INIT AND STANDBY											R				R			R																	
4 WIRE SHORT							R	R			R				R			R				R		R	R										
4 WIRE 1 OHM				R	R	R					R				R			R				R		R	R										
4 WIRE 1.9 OHM				R	R						R				R			R				R		R	R					R					
4 WIRE 10 OHM											R				R			R				R		R	R										
4 WIRE 19 OHM											R				R			R				R		R	R										
4 WIRE 100 OHM											R				R			R				R		R	R										
4 WIRE 190 OHM											R				R			R				R		R	R										
4 WIRE 1K OHM											R				R			R				R		R	R										
4 WIRE 1.9K OHM											R				R			R				R		R	R										
4 WIRE 10K OHM											R				R			R				R		R	R										
4 WIRE 19K OHM											R				R			R				R		R	R										
4 WIRE 100K OHM											R				R			R				R		R	R										
4 WIRE 190K OHM											R				R			R				R		R	R										
4 WIRE 1M OHM											R				R			R				R		R	R										
4 WIRE 1.9M OHM											R				R			R				R		R	R										
4 WIRE 10M OHM											R				R			R				R		R	R										
4 WIRE 19M OHM											R				R			R				R		R	R										
2 WIRE 100M OHM											R				R			R				R		R											
2 WIRE COMP. SHORT							R	R			R				R			R						R				R	R						■
2 WIRE COMP. 1 OHM				R	R	R					R				R			R						R				R	R						■
2 WIRE COMP. 1.9 OHM				R	R						R				R			R						R				R	R	R					■
2 WIRE COMP. 10 OHM											R				R			R						R				R	R						■
2 WIRE COMP. 19 OHM											R				R			R						R				R	R						■
2 WIRE COMP. 100 OHM											R				R			R						R				R	R						■
2 WIRE COMP. 190 OHM											R				R			R						R				R	R						■
2 WIRE COMP. 1K OHM											R				R			R						R				R	R						■
2 WIRE COMP. 1.9K OHM											R				R			R						R				R	R						■
2 WIRE COMP. 10K OHM											R				R			R						R				R	R						■
2 WIRE COMP. 19K OHM											R				R			R						R				R	R						■
DIAG SOURCE10									R	R	R	R										R	R				R				R				
DIAG SOURCES5									R	R	R	R										R	R				R				R	■			
DIAG SOURCE2									R	R	R	R										R	R				R				R	■	■		
DIAG DIFFAMP									R	R		R					R	R		R	R	R					R								
DIAG DIVIDER1									R	R		R				R		R		R	R	R					R								
DIAG DIVIDER2									R	R		R			R			R		R	R	R					R								
DIAG 10K CAL									R	R		R					R		R			R	R				R				R				
DIAG 19K CAL									R	R		R					R		R			R	R				R				R				
DIAG CHK 10K	R									R		R										R	R				R				R				
DIAG CHK 19K	R									R		R										R	R				R				R				
DIAG CHK 1K	R									R		R										R	R				R				R				
DIAG CHK 1.9K	R									R		R										R	R				R				R				
DIAG CHK 100	R									R		R										R	R				R				R				
DIAG CHK 190	R									R		R										R	R				R				R				
DIAG CHK 10	R									R		R										R	R				R				R				
DIAG CHK 19	R									R		R										R	R				R				R				
DIAG 10 CAL		R							R	R				R		R				R	R	R					R					■	■		
DIAG 19 CAL		R							R	R				R		R				R	R	R					R					■	■		
DIAG RATIO 100K	R								R	R		R										R	R				R				R				
DIAG RATIO 190K	R								R	R		R										R	R				R				R				
DIAG RATIO 1M			R						R	R		R										R	R				R				R				
DIAG RATIO 1.9M			R						R	R		R										R	R				R				R				
DIAG RATIO 10M			R						R	R		R										R	R				R				R				
DIAG RATIO 19M1			R						R	R		R										R	R				R				R				
DIAG RATIO 19M2			R						R	R		R										R	R				R				R				
DIAG RATIO 100M			R						R	R		R										R	R				R				R				
DIAG CHK 1	R			R	R	R				R												R					R				R			■	
DIAG CHK 1.9	R			R	R					R												R					R			R	R			■	
DIAG CHK SHORT	R						R	R		R												R					R				R			■	
DIAG 2W COMP																						R						R	R						■

R = RESET POSITION FOR LATCHING RELAYS
■ = ENERGIZED POSITION FOR NON LATCHING RELAYS
NOTE: RELAYS SHOWN IN THE SET POSITION ON THE SCHEMATICS

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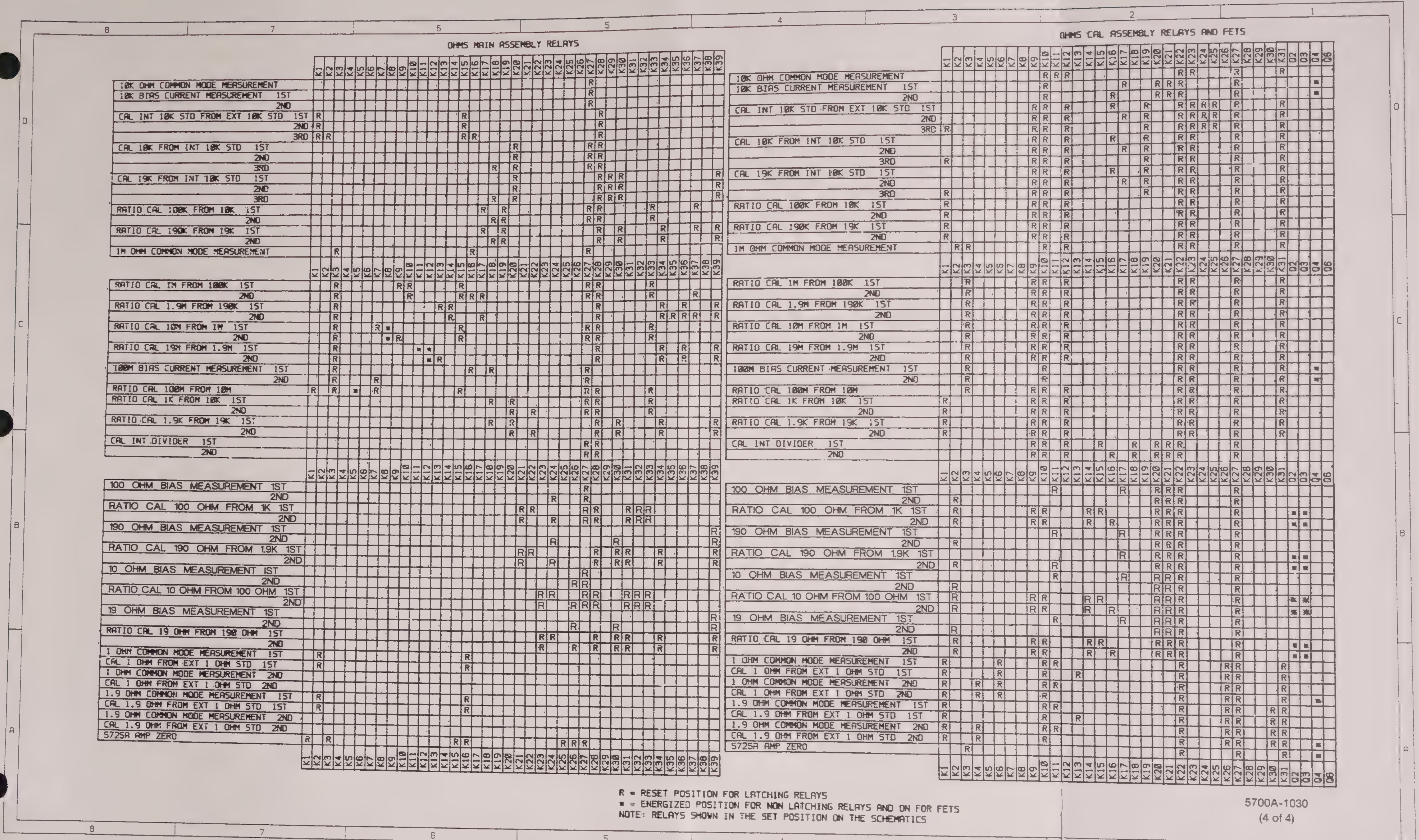
Figure 7-10. A10 Ohms Main PCA (cont)


OHMS MAIN ASSEMBLY RELAYS
10K OHM COMMON MODE MEASUREMENT
10K BIAS CURRENT MEASUREMENT 1ST 2ND
CAL INT 10K STD FROM EXT 10K STD 1ST 2ND 3RD
CAL 10K FROM INT 10K STD 1ST 2ND 3RD
CAL 19K FROM INT 10K STD 1ST 2ND 3RD
RATIO CAL 100K FROM 10K 1ST 2ND
RATIO CAL 190K FROM 19K 1ST 2ND
1M OHM COMMON MODE MEASUREMENT
RATIO CAL 1M FROM 100K 1ST 2ND
RATIO CAL 1.9M FROM 190K 1ST 2ND
RATIO CAL 10M FROM 1M 1ST 2ND
RATIO CAL 19M FROM 1.9M 1ST 2ND
100M BIAS CURRENT MEASUREMENT 1ST 2ND
RATIO CAL 100M FROM 10M
RATIO CAL 1K FROM 10K 1ST 2ND
RATIO CAL 1.9K FROM 19K 1ST 2ND
CAL INT DIVIDER 1ST 2ND
100 OHM BIAS MEASUREMENT 1ST 2ND
RATIO CAL 100 OHM FROM 1K 1ST 2ND
190 OHM BIAS MEASUREMENT 1ST 2ND
RATIO CAL 190 OHM FROM 1.9K 1ST 2ND
10 OHM BIAS MEASUREMENT 1ST 2ND
RATIO CAL 10 OHM FROM 100 OHM 1ST 2ND
19 OHM BIAS MEASUREMENT 1ST 2ND
RATIO CAL 19 OHM FROM 190 OHM 1ST 2ND
1 OHM COMMON MODE MEASUREMENT 1ST
CAL 1 OHM FROM EXT 1 OHM STD 1ST
1 OHM COMMON MODE MEASUREMENT 2ND
CAL 1 OHM FROM EXT 1 OHM STD 2ND
1.9 OHM COMMON MODE MEASUREMENT 1ST
CAL 1.9 OHM FROM EXT 1 OHM STD 1ST
1.9 OHM COMMON MODE MEASUREMENT 2ND
CAL 1.9 OHM FROM EXT 1 OHM STD 2ND
5725A AMP ZERO
K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 K11 K12 K13 K14 K15 K16 K17 K18 K19 K20 K21 K22 K23 K24 K25 K26 K27 K28 K29 K30 K31 K32 K33 K34 K35 K36 K37 K38 K39
OHMS CAL ASSEMBLY RELAYS AND FETS
K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 K11 K12 K13 K14 K15 K16 K17 K18 K19 K20 K21 K22 K23 K24 K25 K26 K27 K28 K29 K30 K31 Q2 Q3 Q4 Q6
R
■
8 7 6 5 4 3 2 1
D C B A

R = RESET POSITION FOR LATCHING RELAYS
■ = ENERGIZED POSITION FOR NON LATCHING RELAYS AND ON FOR FETS
NOTE: RELAYS SHOWN IN THE SET POSITION ON THE SCHEMATICS

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Figure 7-10. A10 Ohms Main PCA (cont)

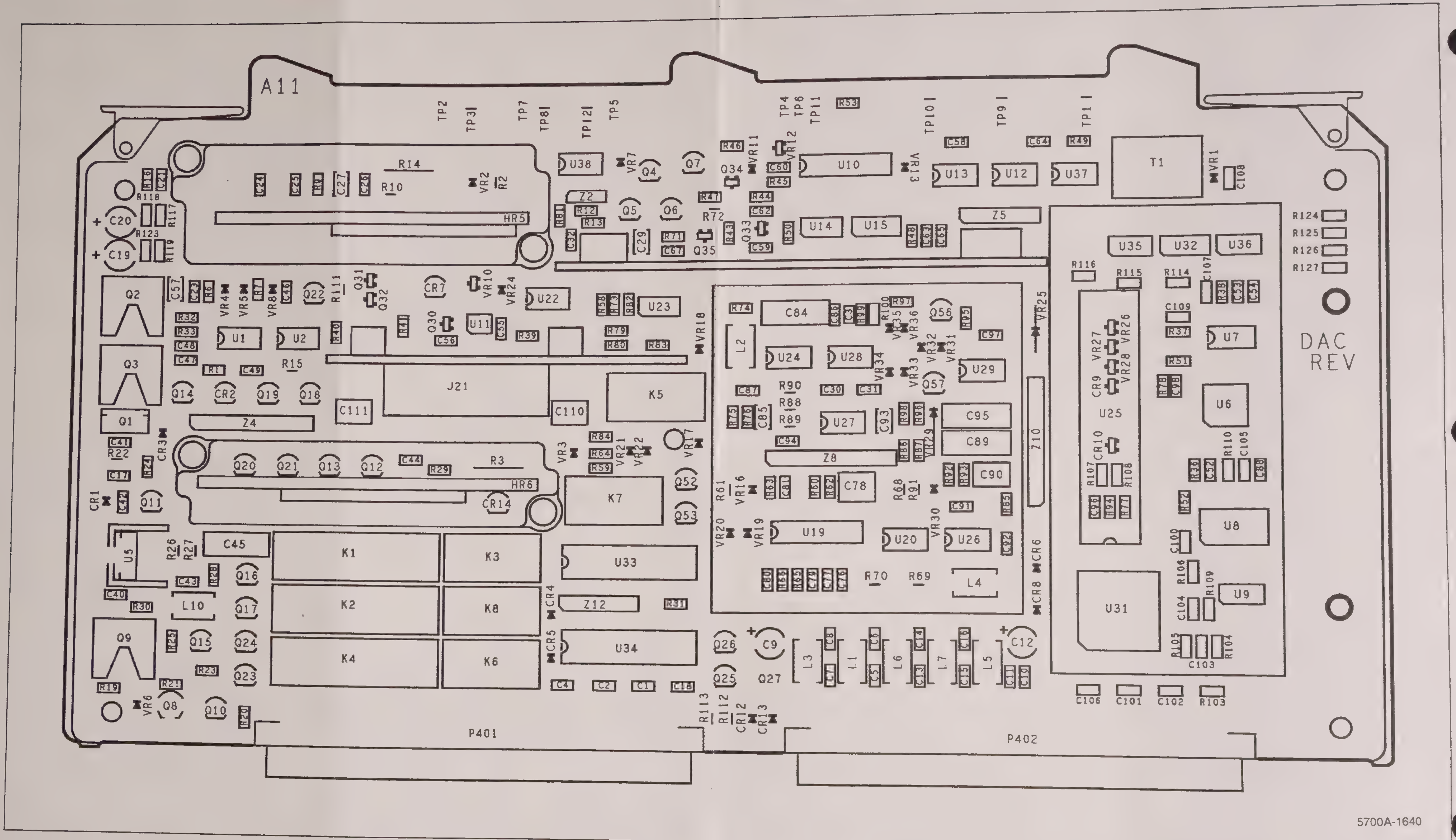
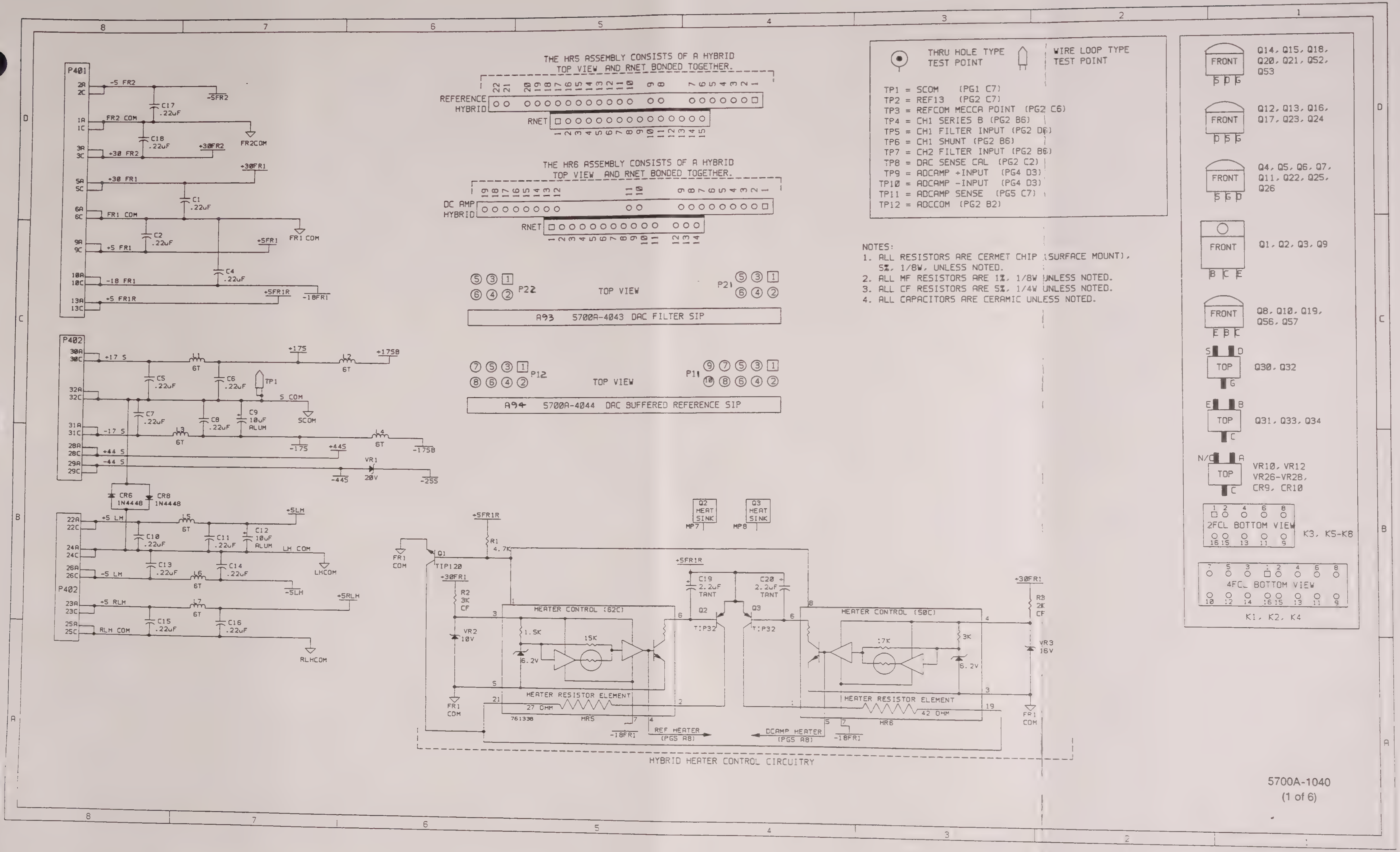


Figure 7-11. A11 DAC PCA

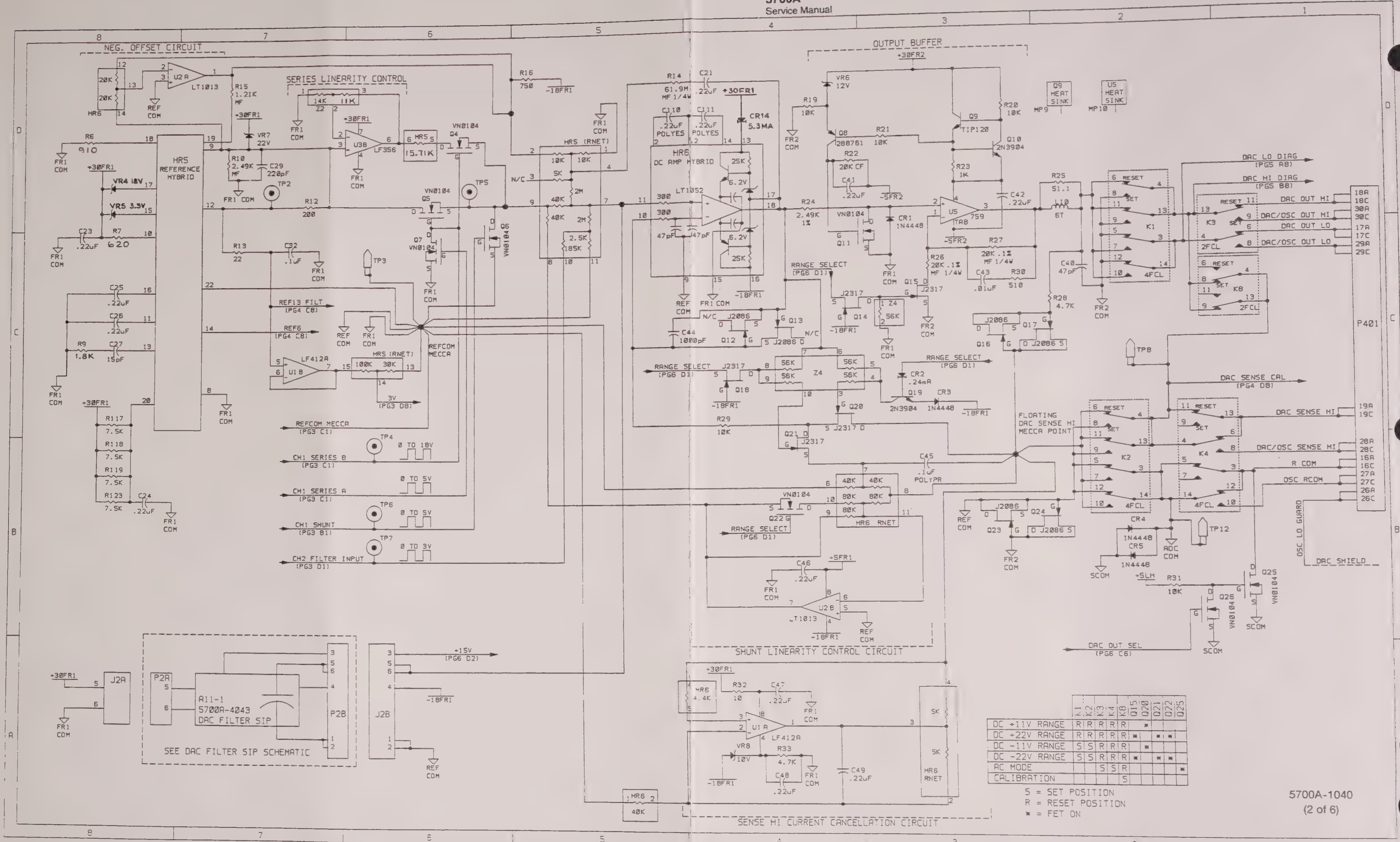


TP1 = SCOM (PG1 C7)
TP2 = REF13 (PG2 C7)
TP3 = REFCOM MECCA POINT (PG2 C6)
TP4 = CH1 SERIES B (PG2 B6)
TP5 = CH1 FILTER INPUT (PG2 D6)
TP6 = CH1 SHUNT (PG2 B6)
TP7 = CH2 FILTER INPUT (PG2 B6)
TP8 = DAC SENSE CAL (PG2 C2)
TP9 = ADCAMP +INPUT (PG4 D3)
TP10 = ADCAMP -INPUT (PG4 D3)
TP11 = ADCAMP SENSE (PG5 C7)
TP12 = ADCCOM (PG2 B2)

NOTES:

1. ALL RESISTORS ARE CERMET CHIP (SURFACE MOUNT), 5%, 1/8W, UNLESS NOTED.
2. ALL MF RESISTORS ARE 1%, 1/8W UNLESS NOTED.
3. ALL CF RESISTORS ARE 5%, 1/4W UNLESS NOTED.
4. ALL CAPACITORS ARE CERAMIC UNLESS NOTED.

Figure 7-11. A11 DAC PCA (cont)



	K1	K2	K3	K4	K8	Q15	Q20	Q21	Q22	Q25
DC +11V RANGE	R	R	R	R	R		*			
DC +22V RANGE	R	R	R	R	R	*		*	*	
DC -11V RANGE	S	S	R	R	R		*			
DC -22V RANGE	S	S	R	R	R	*		*	*	
AC MODE			S	S	R					*
CALIBRATION					S					

S = SET POSITION
R = RESET POSITION
* = FET ON

Figure 7-11. A11 DAC PCA (cont)

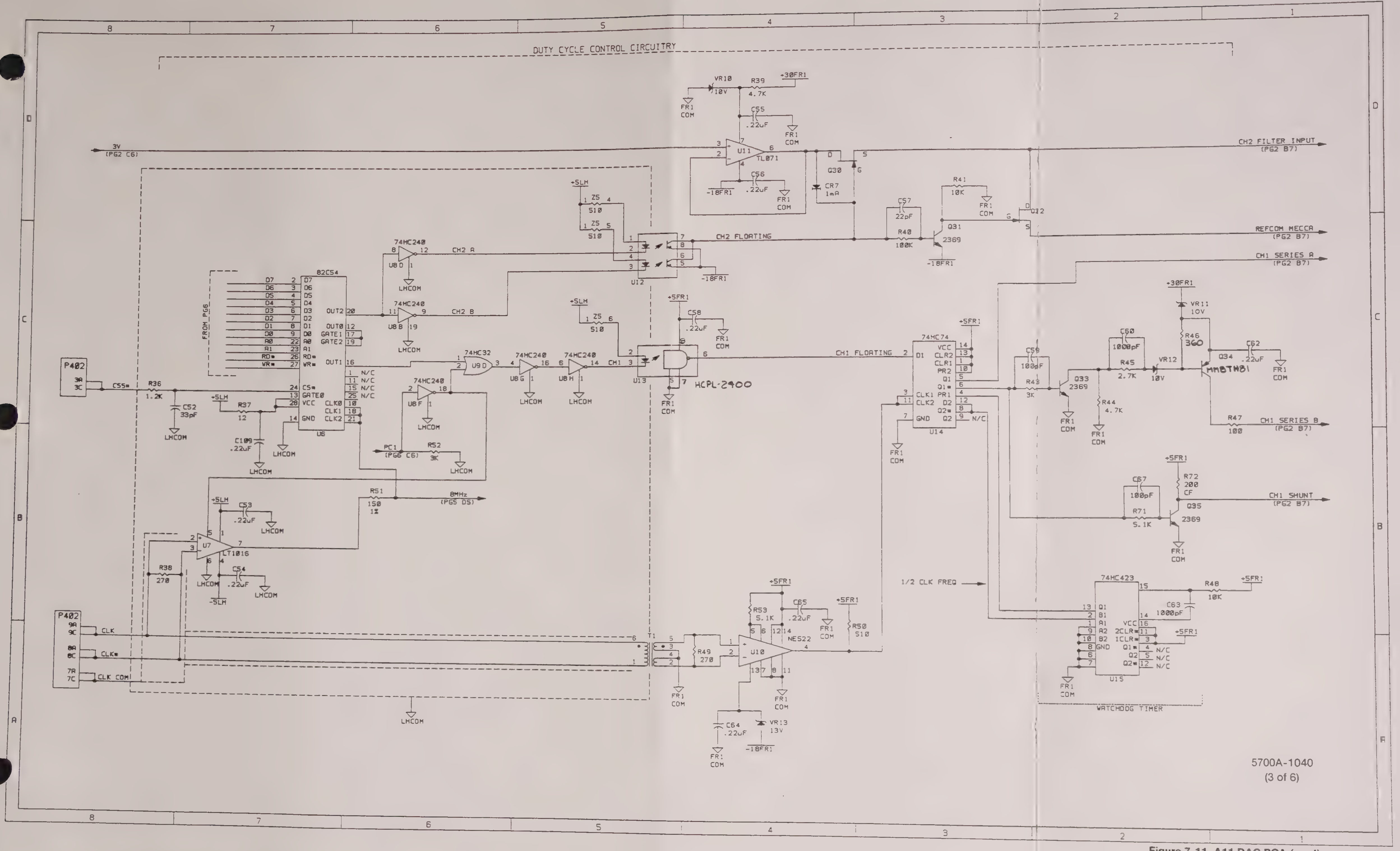


Figure 7-11. A11 DAC PCA (cont)

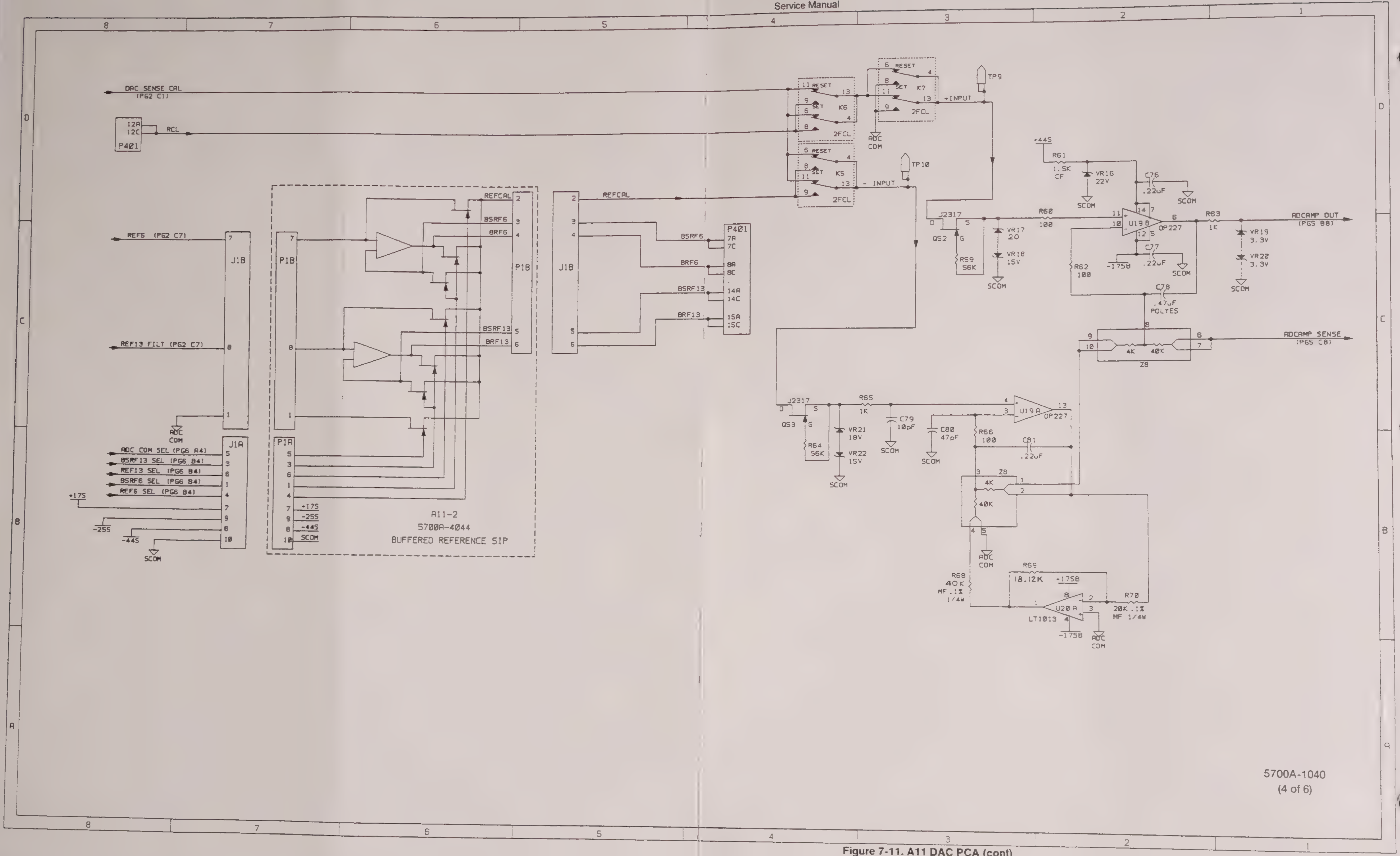


Figure 7-11. A11 DAC PCA (cont)

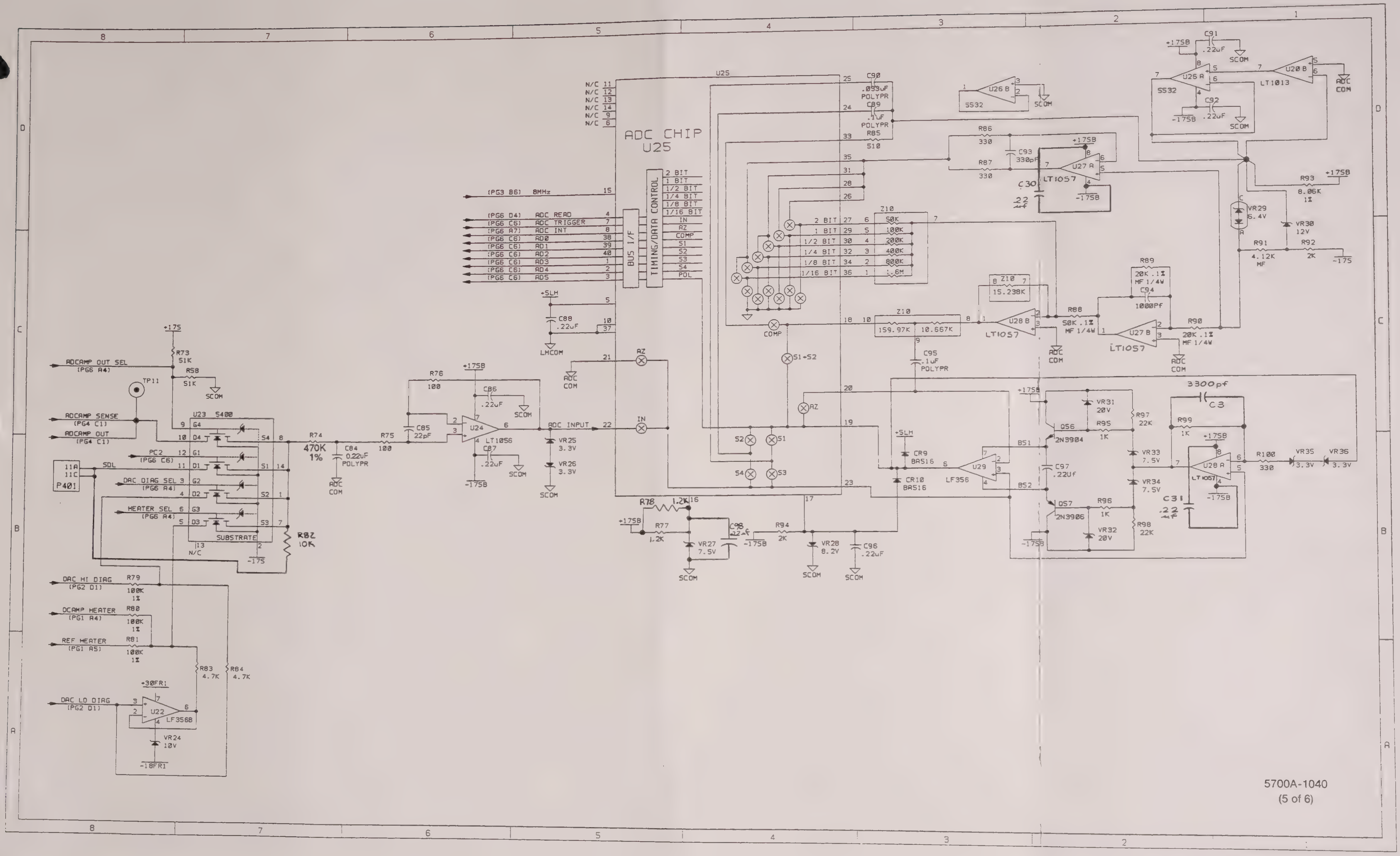


Figure 7-11. A11 DAC PCA (cont)

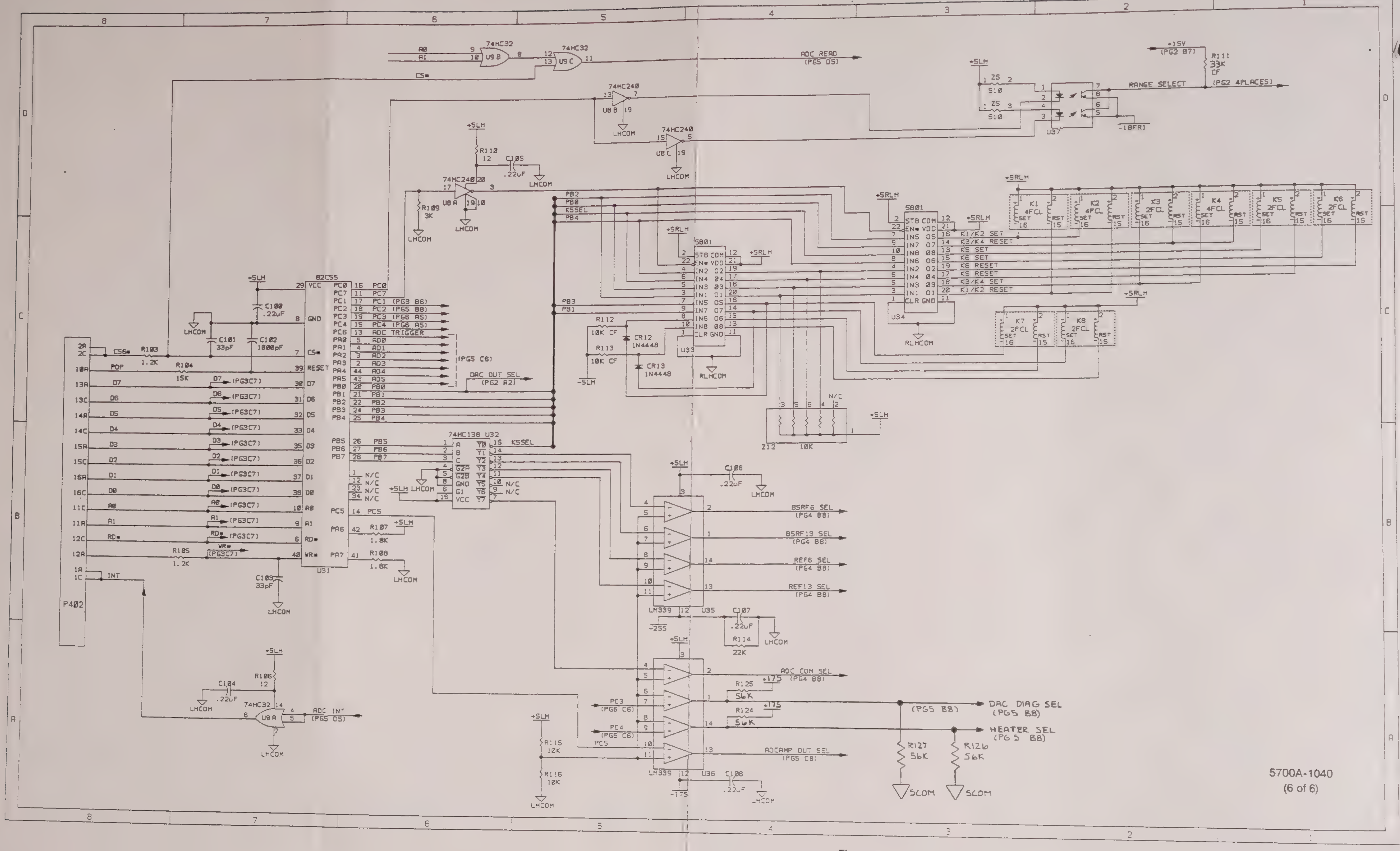
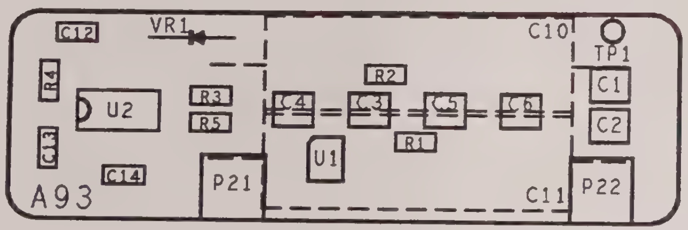


Figure 7-11. A11 DAC PCA (cont)



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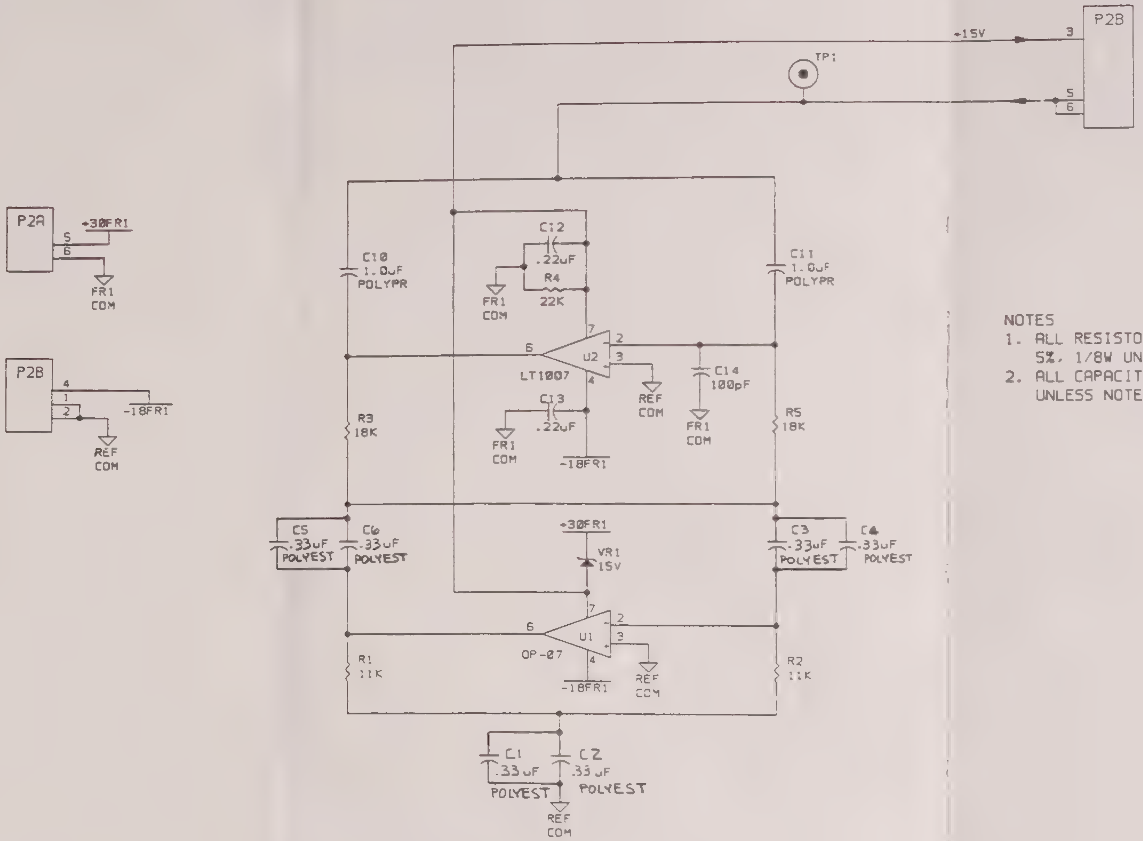

NOTES
1. ALL RESISTORS ARE CERMET CHIP (SURFACE MOUNT), 5%, 1/8W UNLESS NOTED.
2. ALL CAPACITORS ARE CERAMIC (SURFACE MOUNT), UNLESS NOTED.

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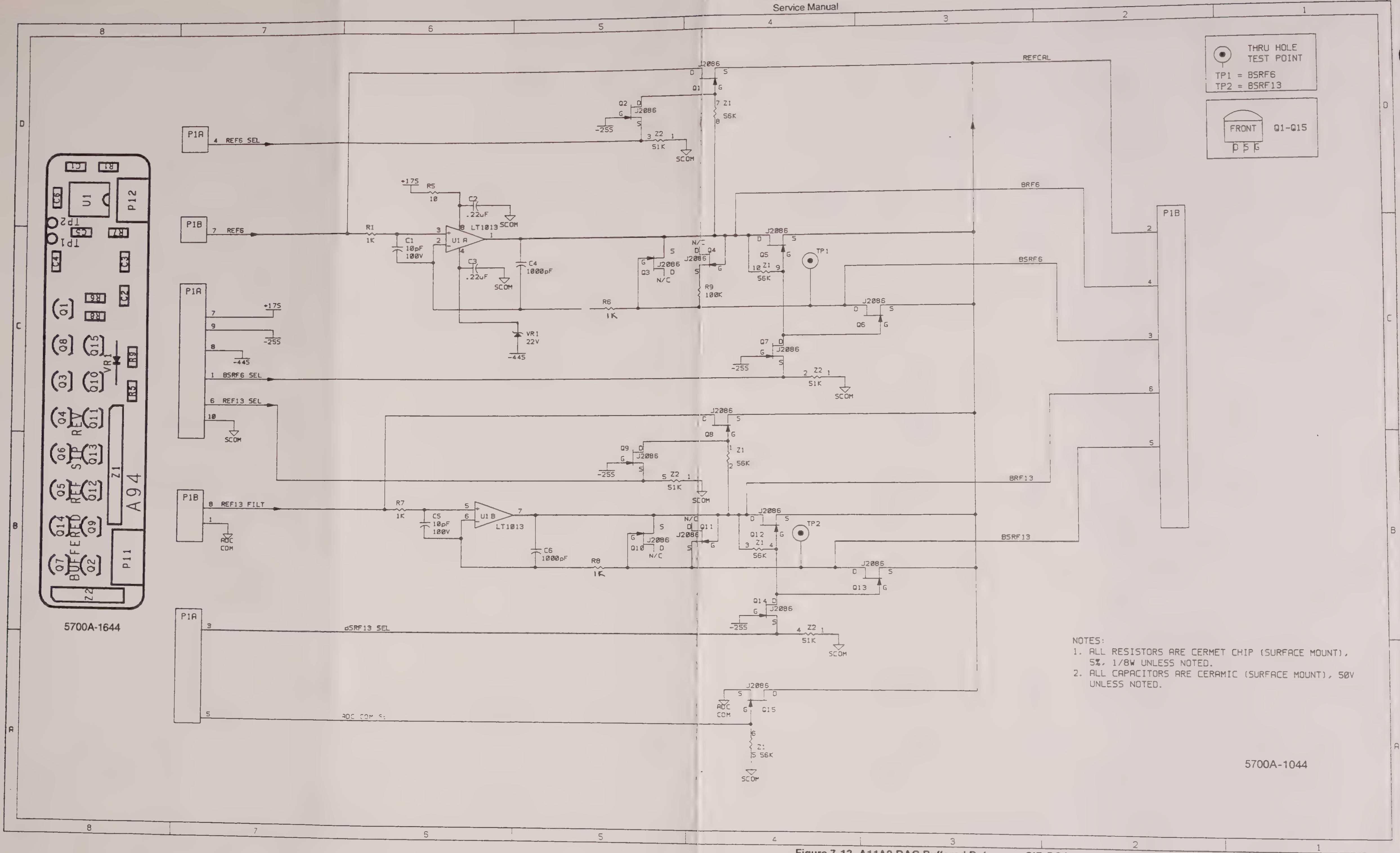
Figure 7-12. A11A1 DAC Filter SIP PCA



NOTES:
1. ALL RESISTORS ARE CERMET CHIP (SURFACE MOUNT), 5%, 1/8W UNLESS NOTED.
2. ALL CAPACITORS ARE CERAMIC (SURFACE MOUNT), 50V UNLESS NOTED.

Figure 7-13. A11A2 DAC Buffered Reference SIP PCA

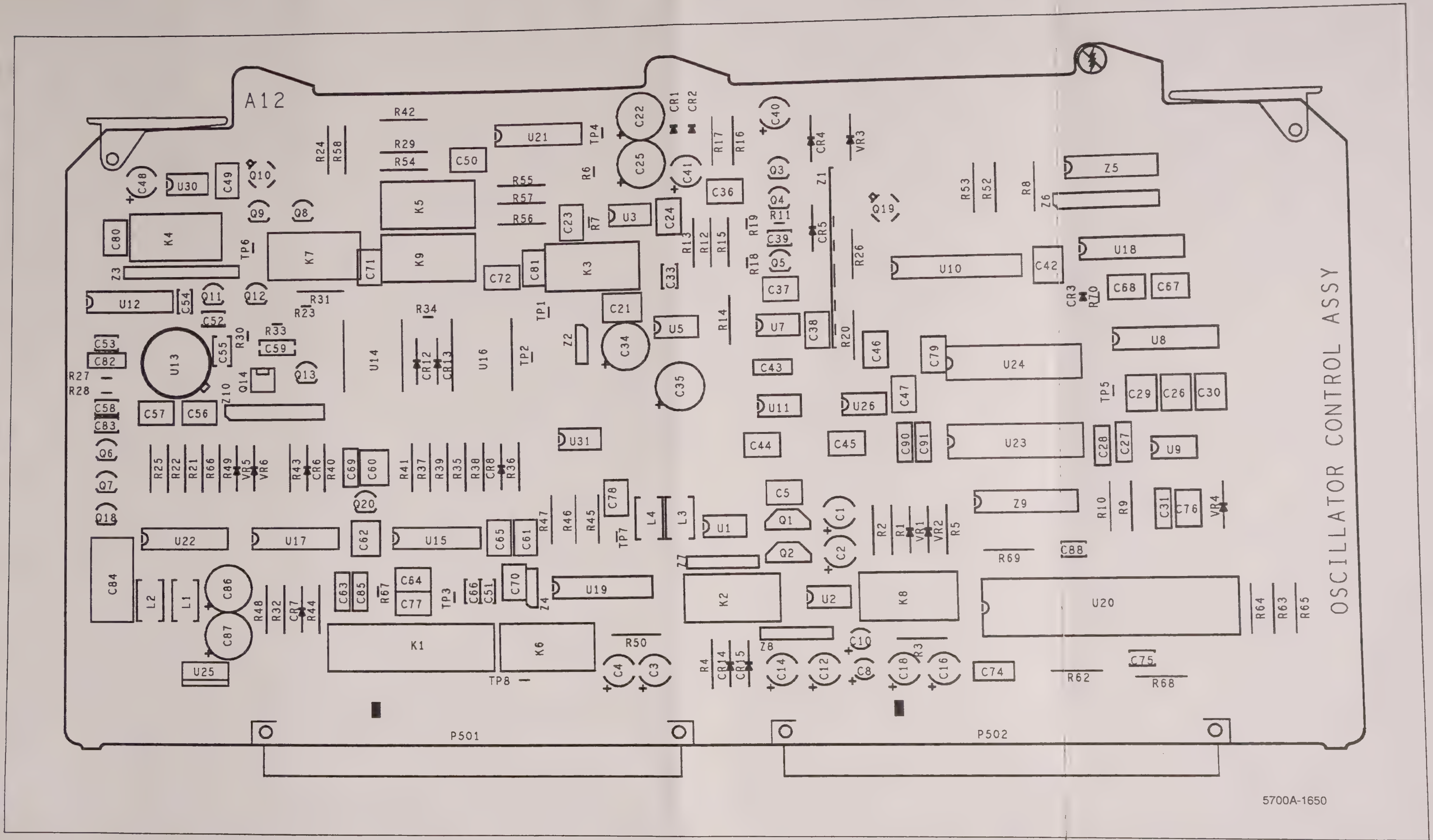


Figure 7-14. A12 Oscillator Control PCA (cont)

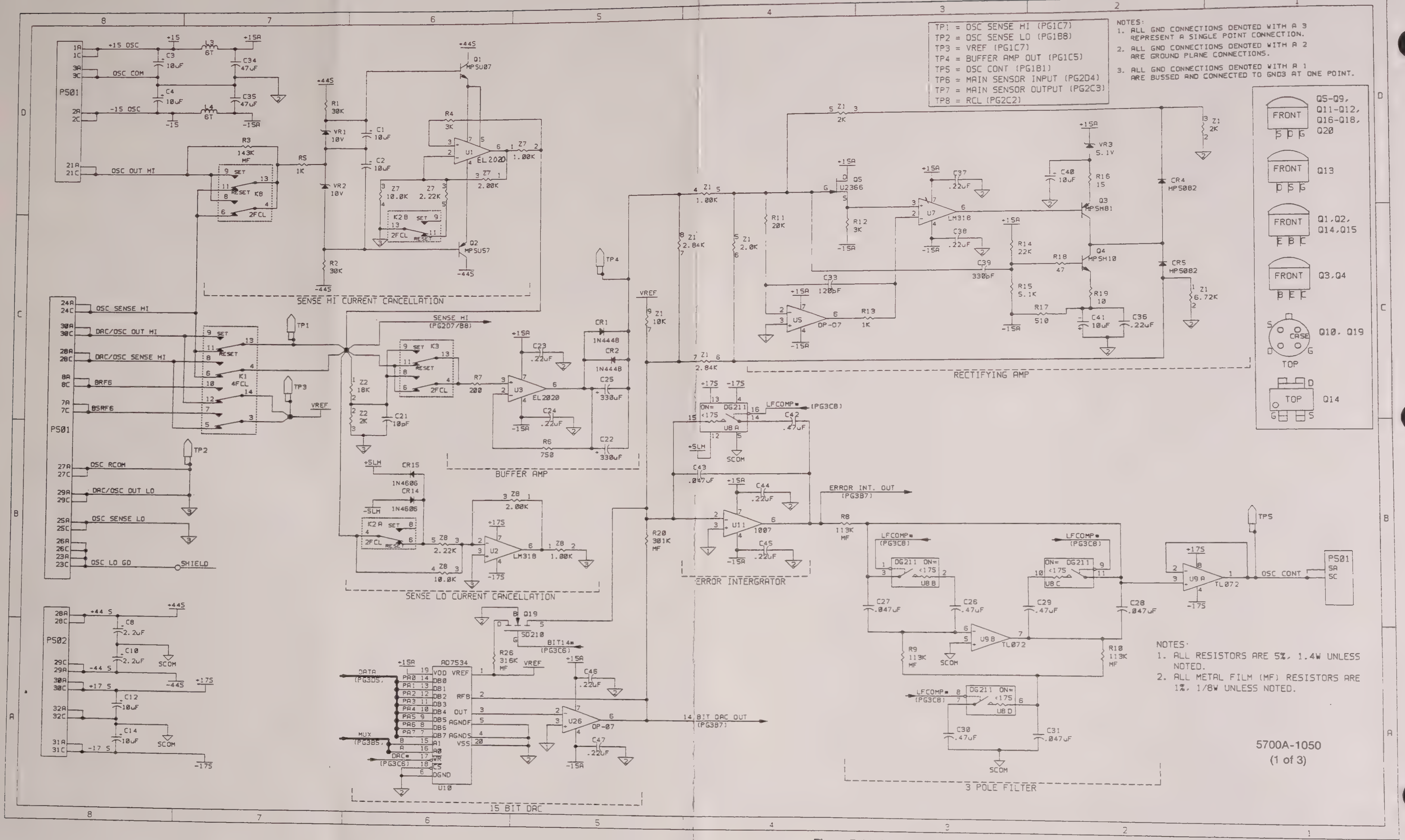


Figure 7-14. A12 Oscillator Control PCA (cont)

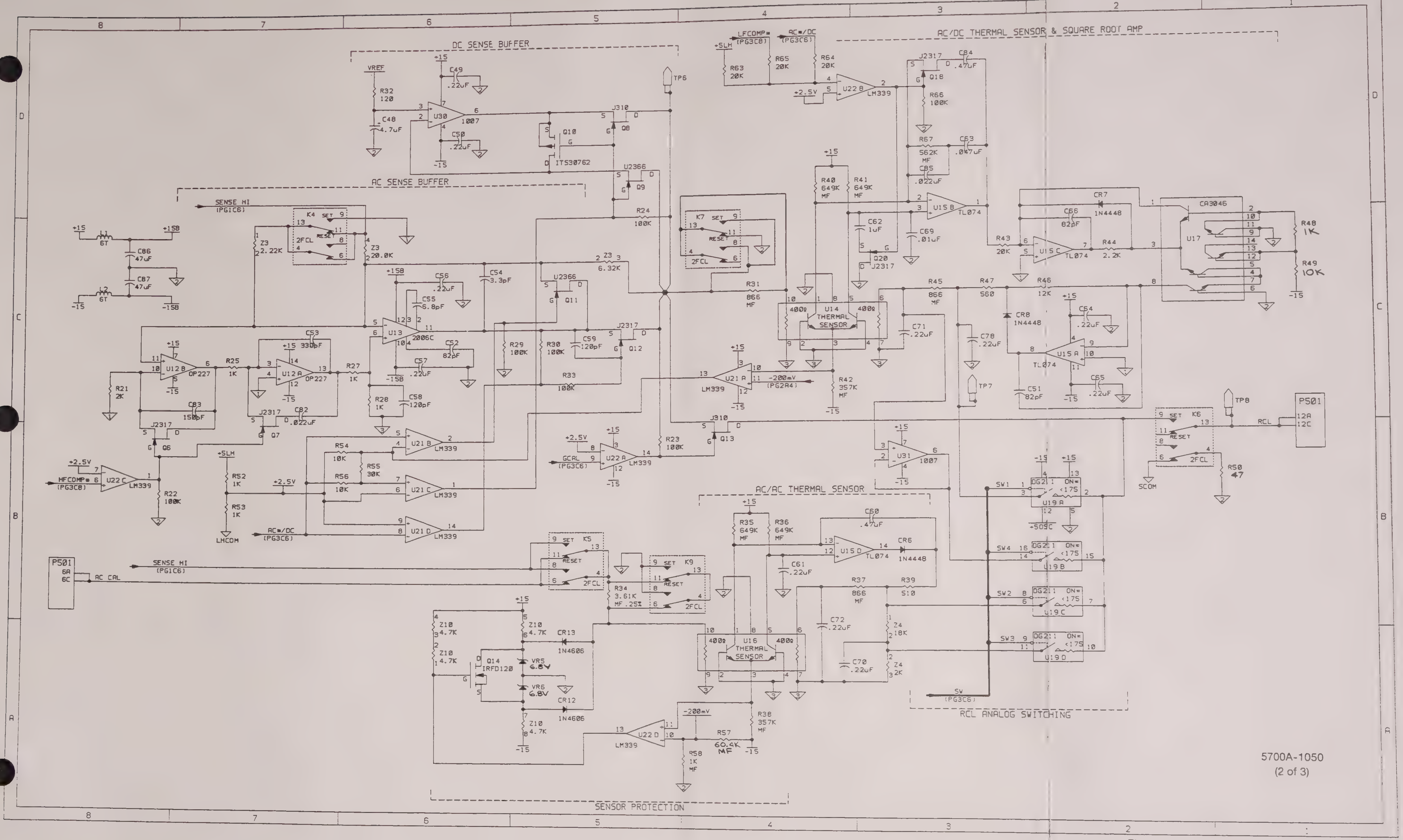
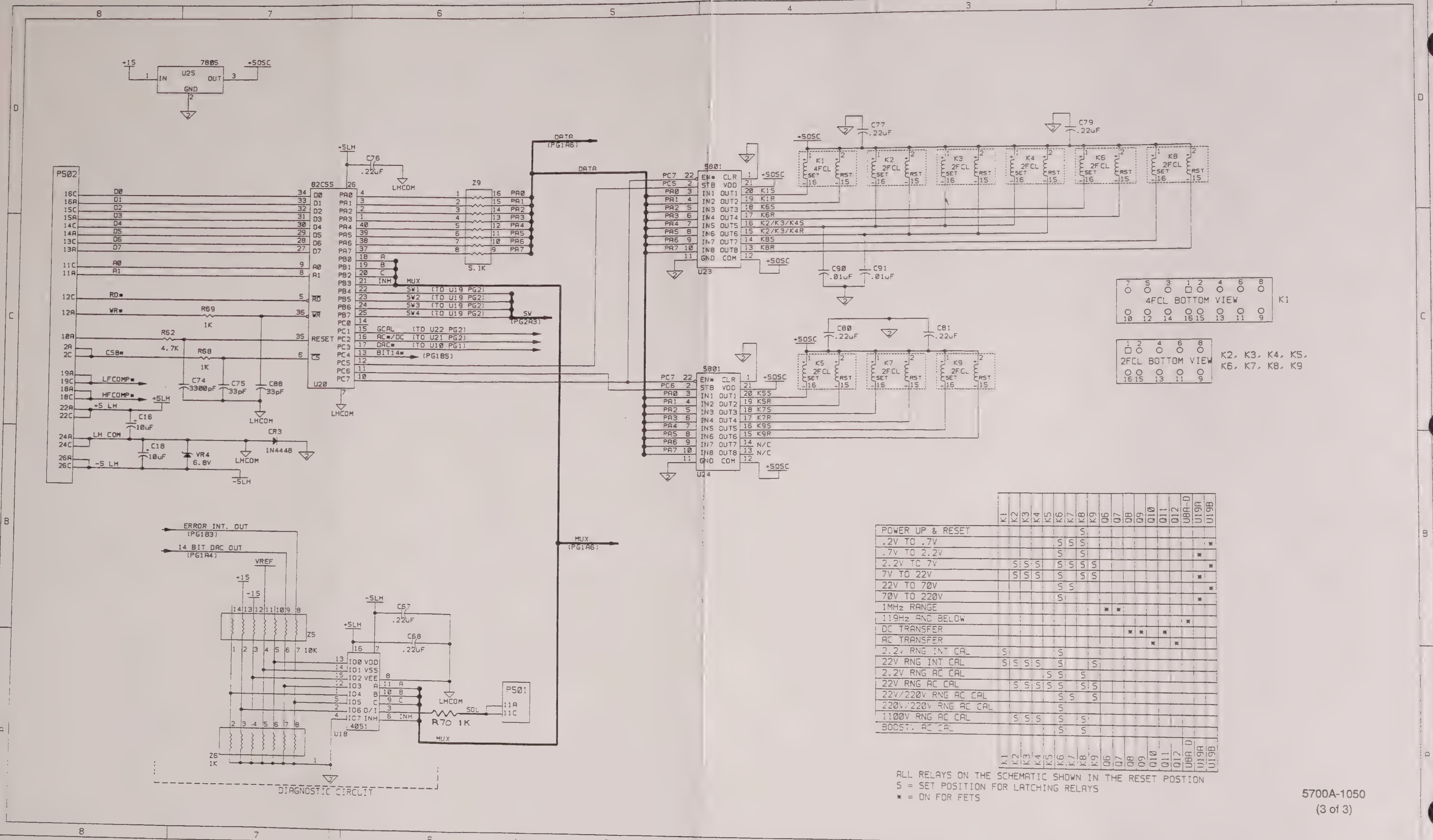


Figure 7-14. A12 Oscillator Control PCA (cont)



	K1	K2	K3	K4	K5	K6	K7	K8	K9	Q6	Q7	Q8	Q9	Q10	Q11	Q12	U8A-D	U19A	U19B
POWER UP & RESET								S											
.2V TO .7V						S	S	S											*
.7V TO 2.2V						S		S										*	
2.2V TO 7V		S	S	S		S	S	S	S										*
7V TO 22V		S	S	S		S		S	S									*	
22V TO 70V						S	S												*
70V TO 220V						S												*	
1MHz RANGE										*	*								
119Hz AND BELOW																	*		
DC TRANSFER												*	*		*				
AC TRANSFER														*		*			
2.2V RNG INT CAL	S					S													
22V RNG INT CAL	S	S	S	S		S			S										
2.2V RNG AC CAL					S	S		S											
22V RNG AC CAL		S	S	S	S	S		S	S										
22V/220V RNG AC CAL						S	S		S										
220V/220V RNG AC CAL						S													
1100V RNG AC CAL		S	S	S		S		S											
BOOST: AC CAL						S		S											

ALL RELAYS ON THE SCHEMATIC SHOWN IN THE RESET POSTION
S = SET POSITION FOR LATCHING RELAYS
* = ON FOR FETS

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Figure 7-14. A12 Oscillator Control PCA (cont)

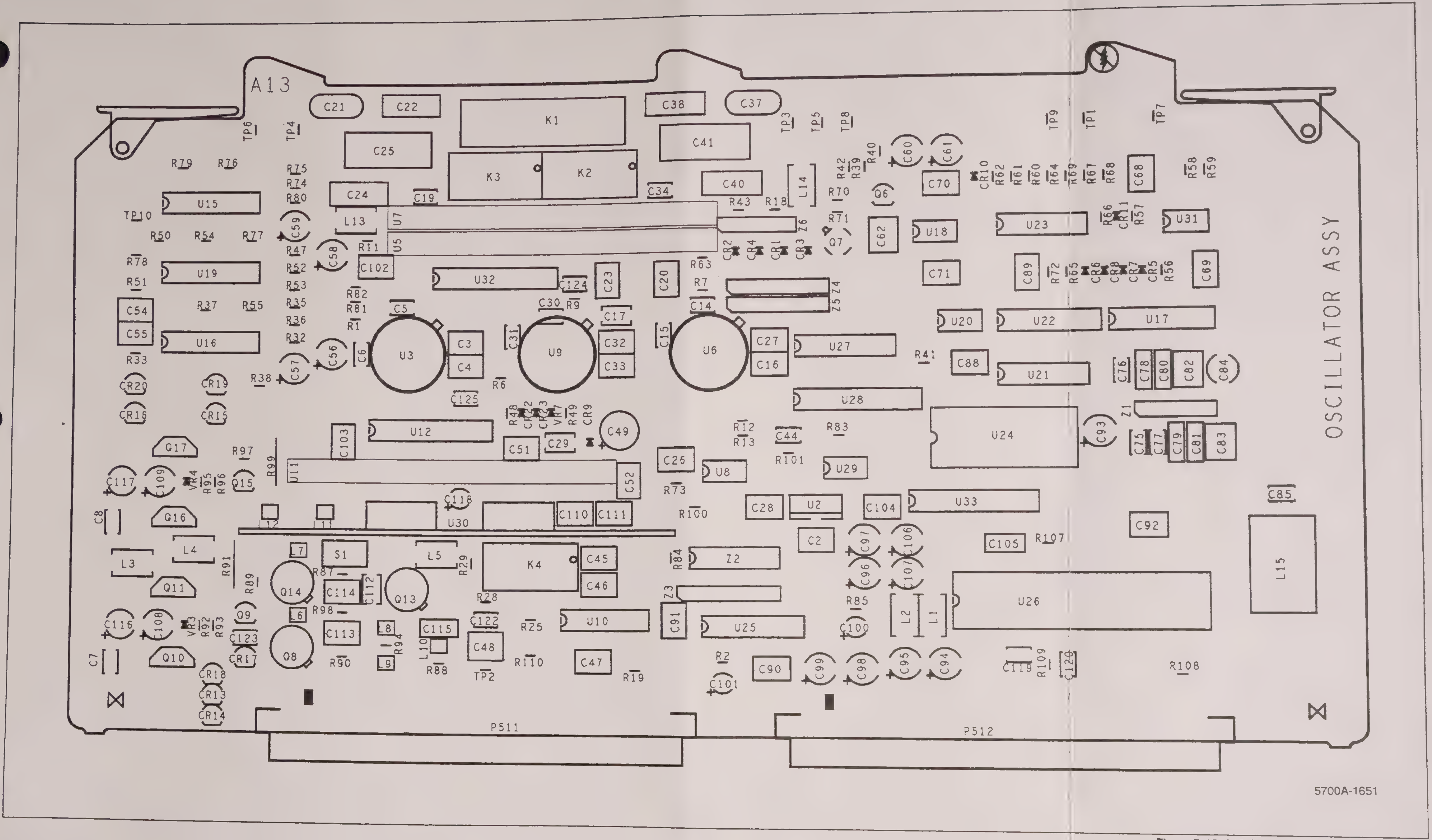

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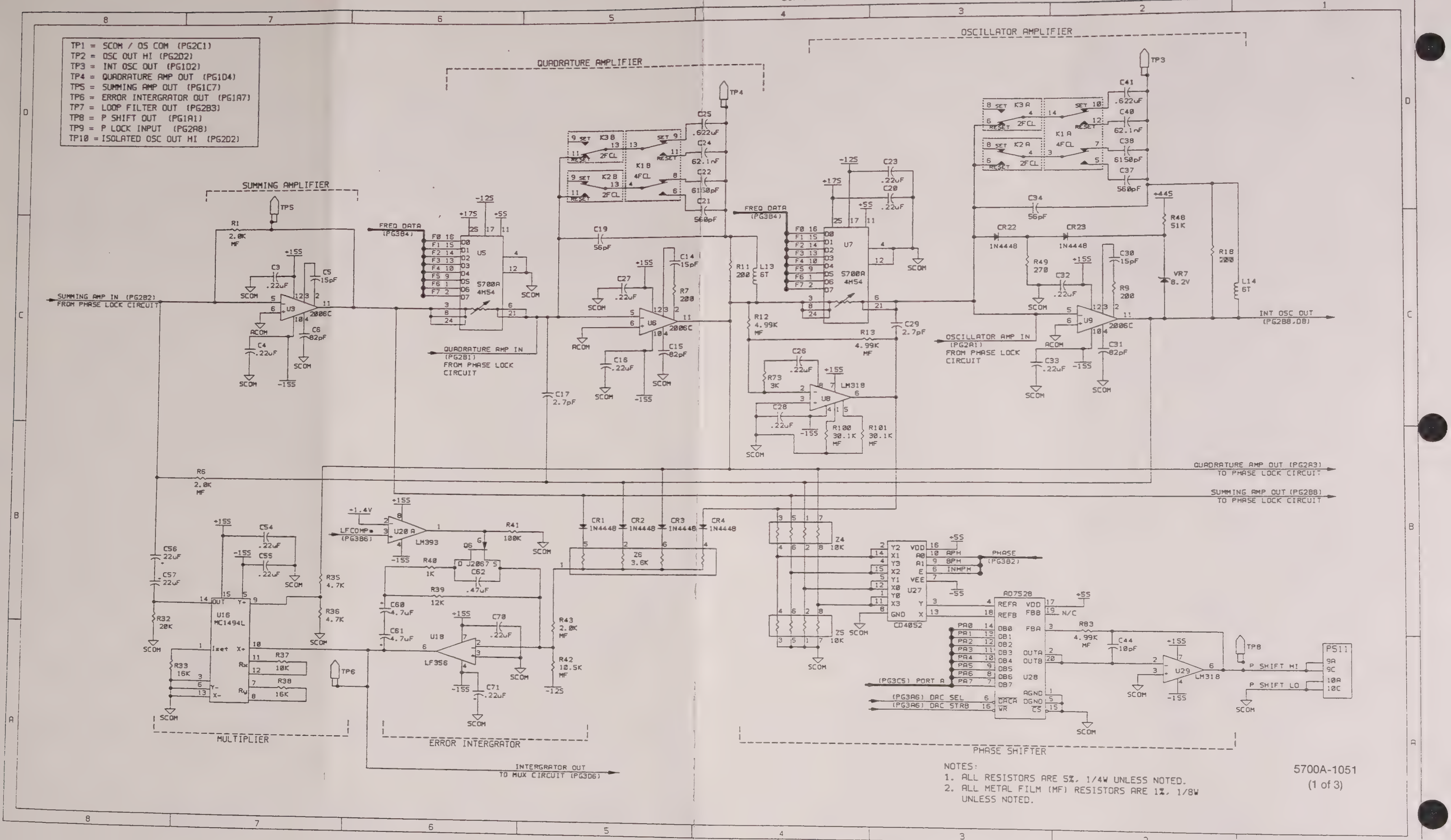
Figure 7-15. A13 Oscillator Output PCA



NOTES:
1. ALL RESISTORS ARE 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

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Figure 7-15. A13 Oscillator Output PCA (cont)

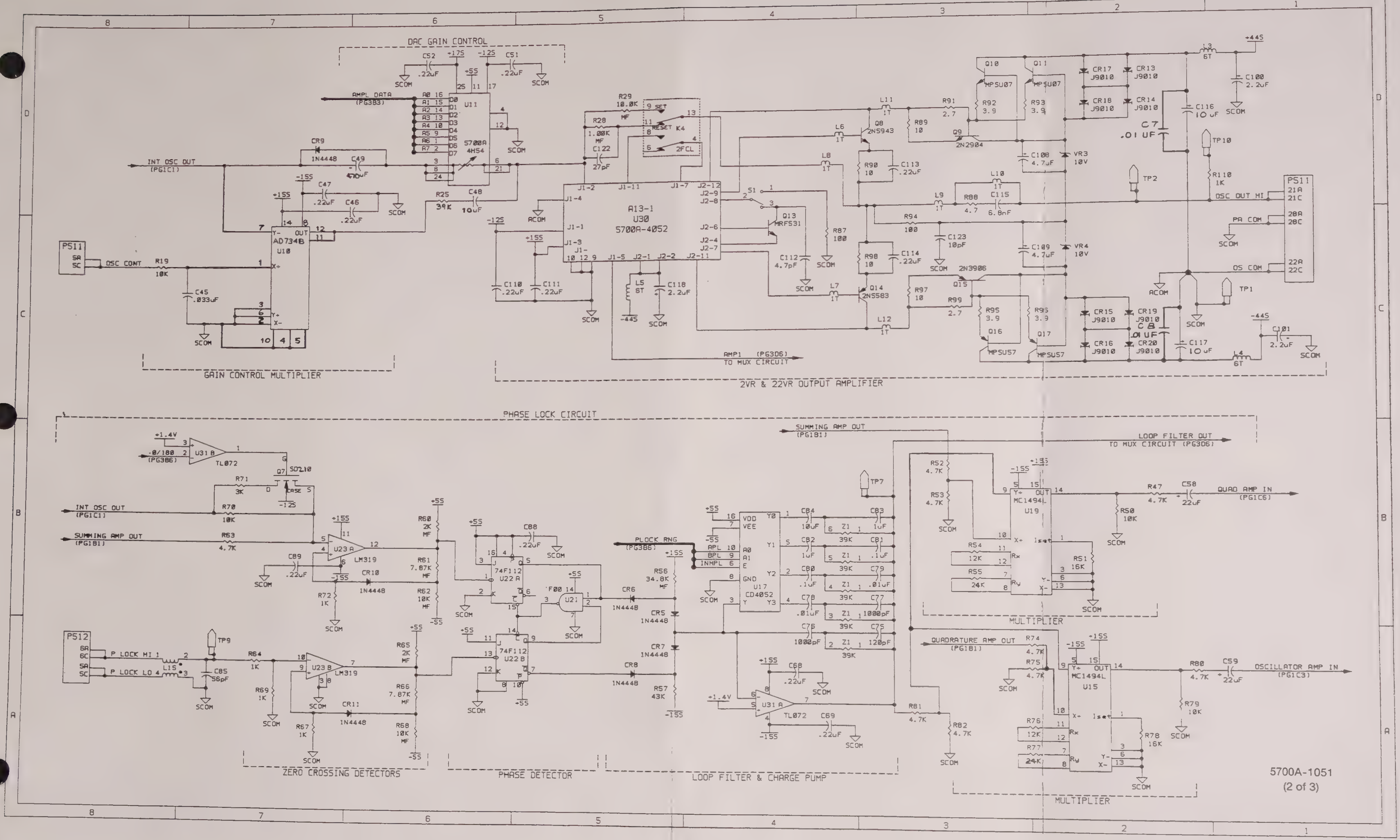
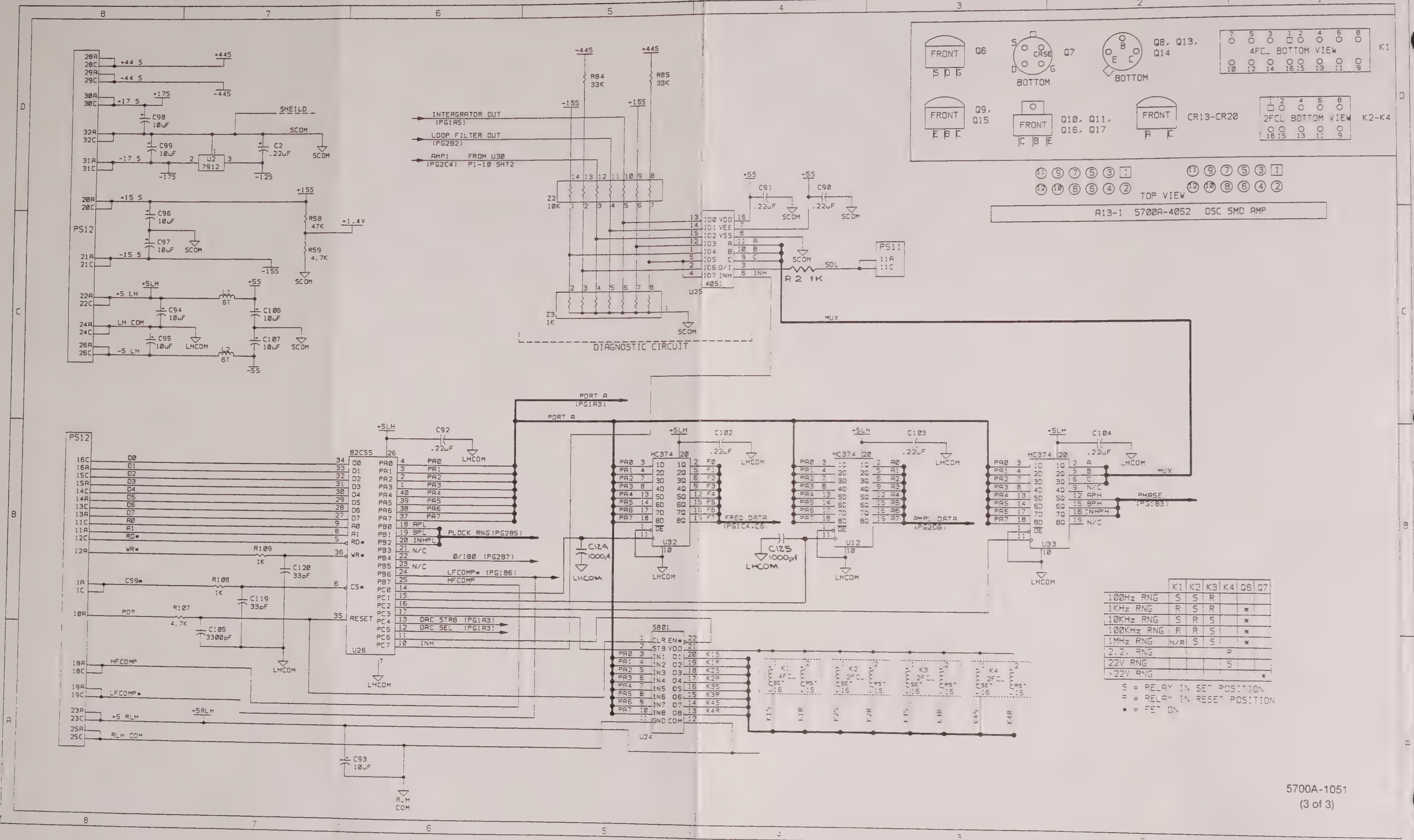


Figure 7-15. A13 Oscillator Output PCA (cont)



	K1	K2	K3	K4	Q6	Q7
100Hz RNG	S	S	R			
1KHz RNG	R	S	R		*	
10KHz RNG	S	R	S		*	
100KHz RNG	R	R	S		*	
1MHz RNG	N/A	S	S		*	
2.2V RNG				R		
22V RNG				S		
>22V RNG						*

S = RELAY IN SET POSITION
R = RELAY IN RESET POSITION
* = FET ON

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Figure 7-15. A13 Oscillator Output PCA (cont)

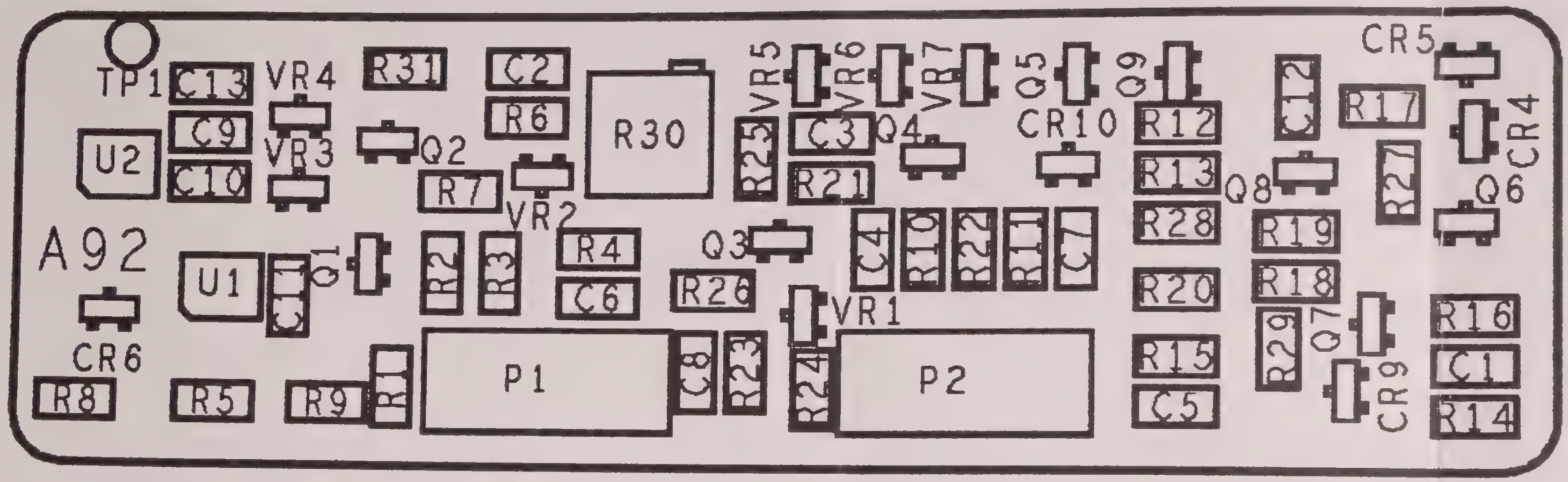

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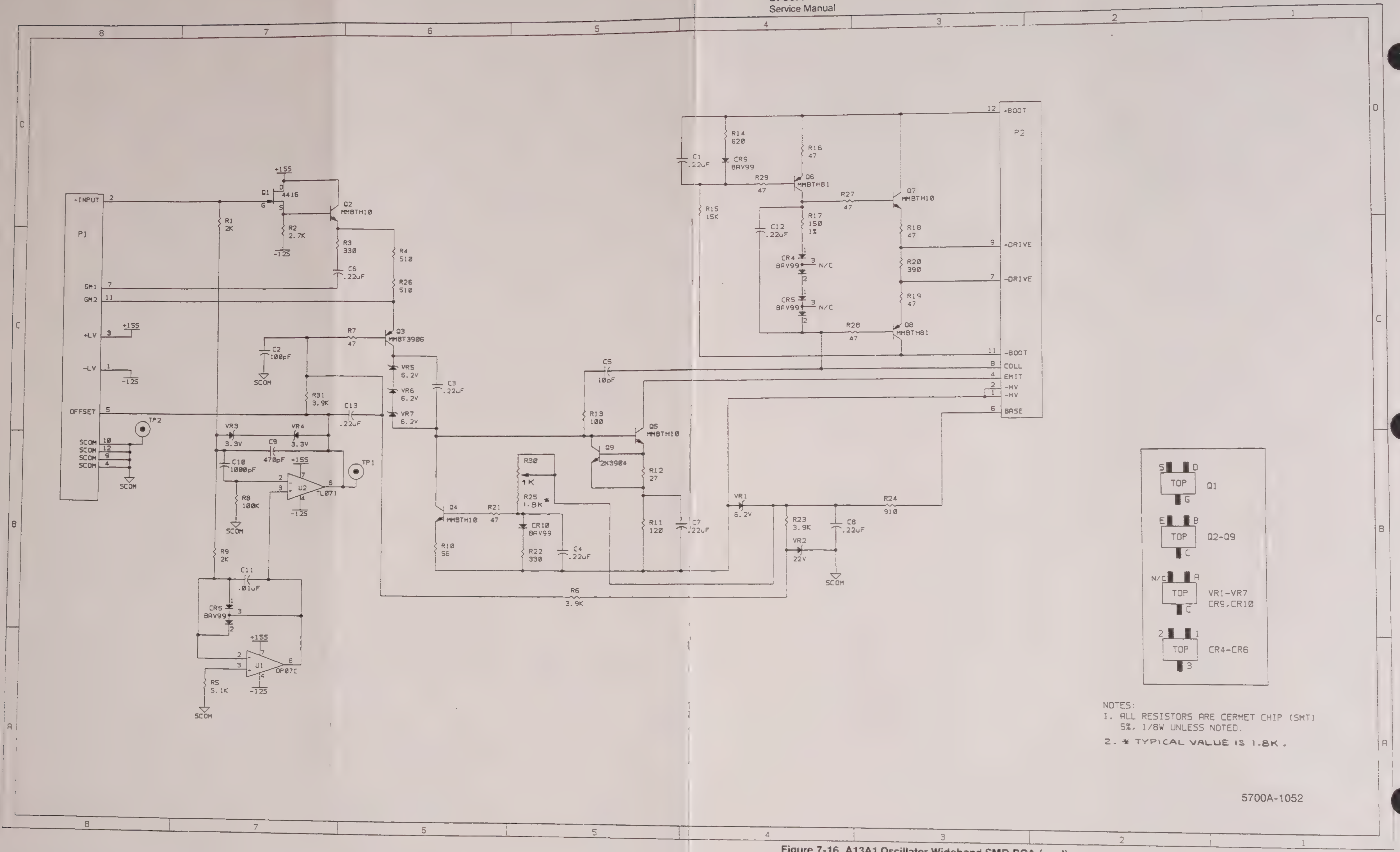
Figure 7-16. A13A1 Oscillator Wideband SMD PCA



NOTES:
1. ALL RESISTORS ARE CERMET CHIP (SMT) 5%, 1/8W UNLESS NOTED.
2. * TYPICAL VALUE IS 1.8K.

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Figure 7-16. A13A1 Oscillator Wideband SMD PCA (cont)

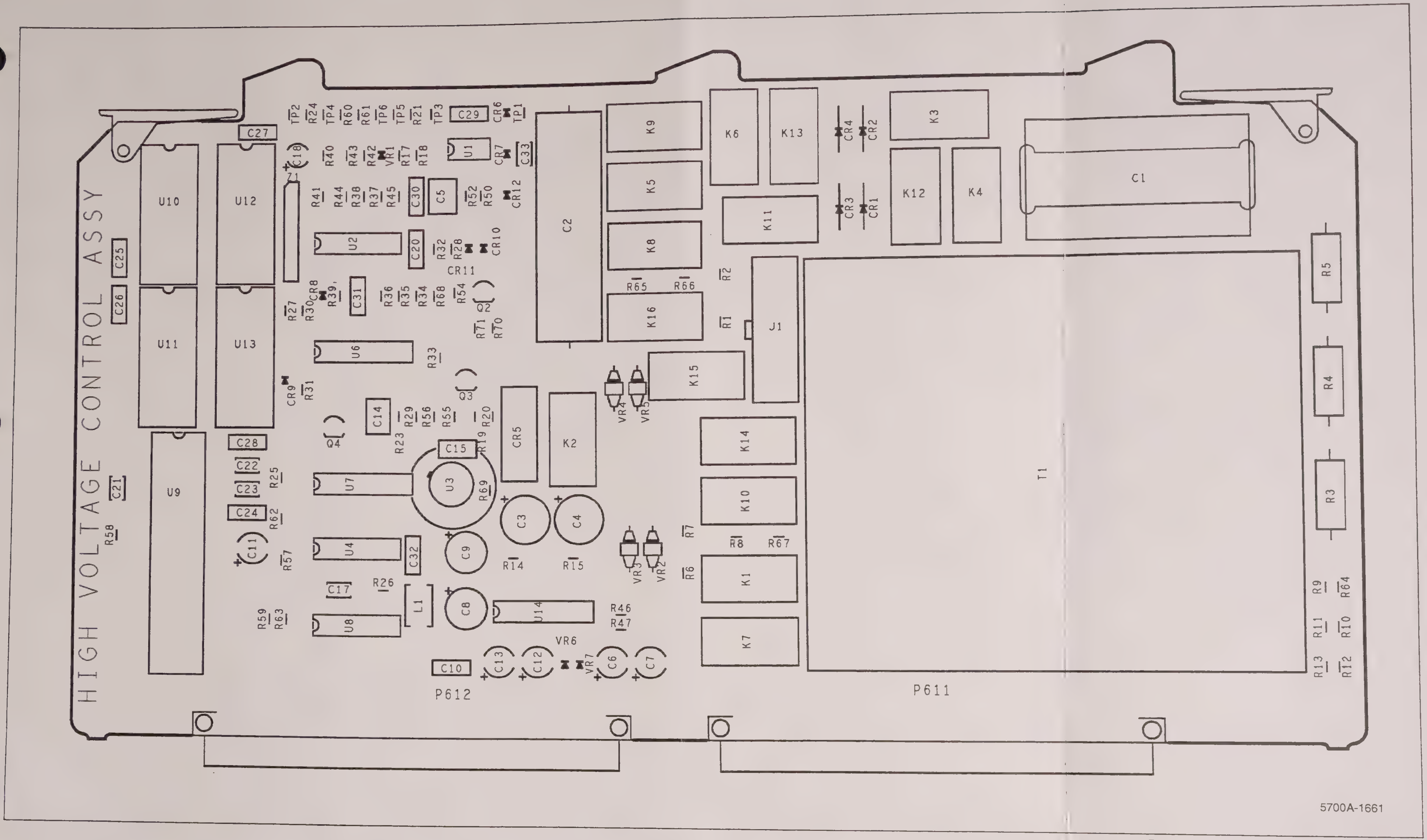
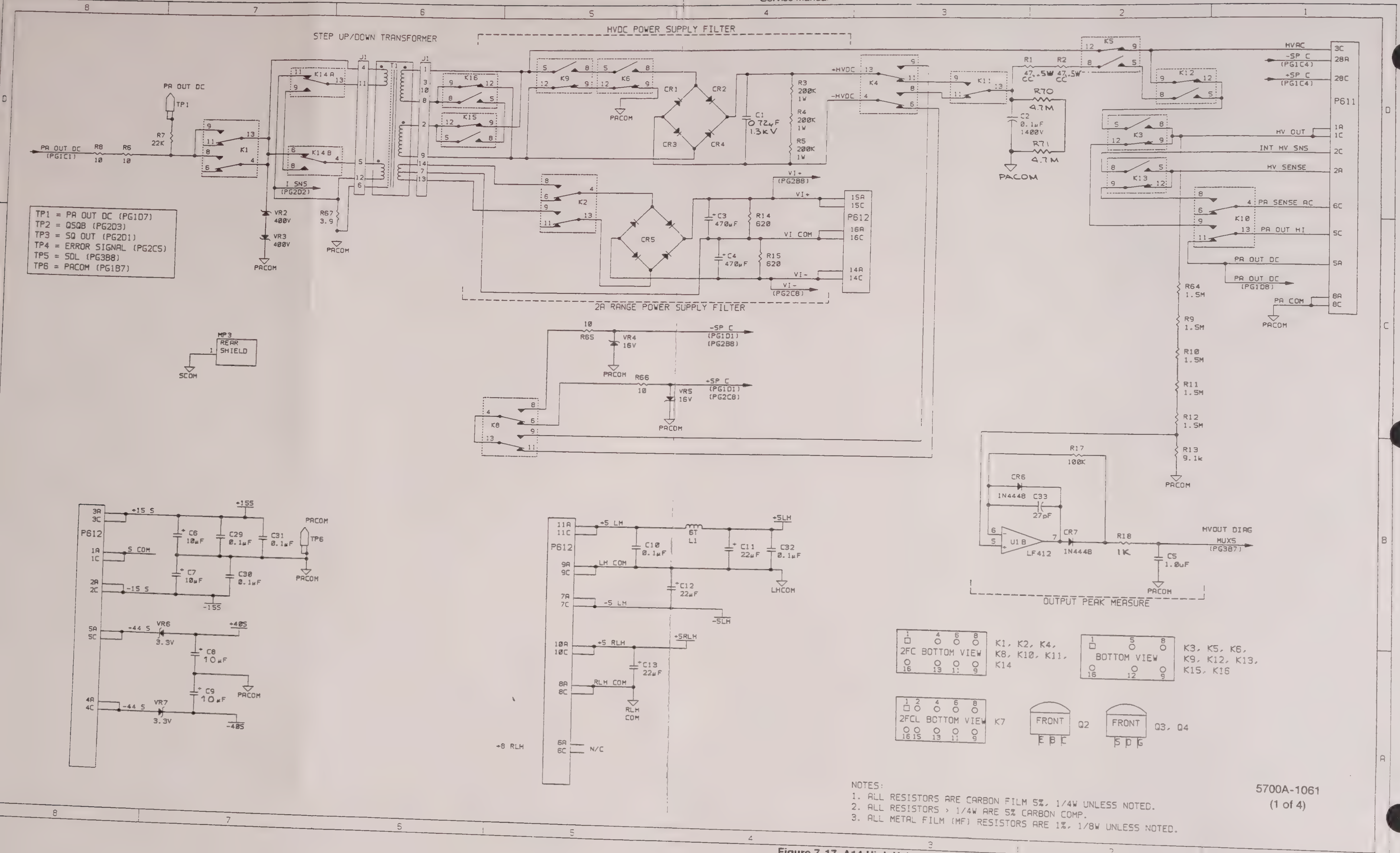


Figure 7-17. A14 High Voltage Control PCA



TP1 = PA OUT DC (PG1D7)
TP2 = QSQB (PG2D3)
TP3 = SQ OUT (PG2D1)
TP4 = ERROR SIGNAL (PG2C5)
TP5 = SDL (PG3B8)
TP6 = PACOM (PG1B7)

NOTES:
1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL RESISTORS > 1/4W ARE 5% CARBON COMP.
3. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

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Figure 7-17. A14 High Voltage Control PCA (cont)

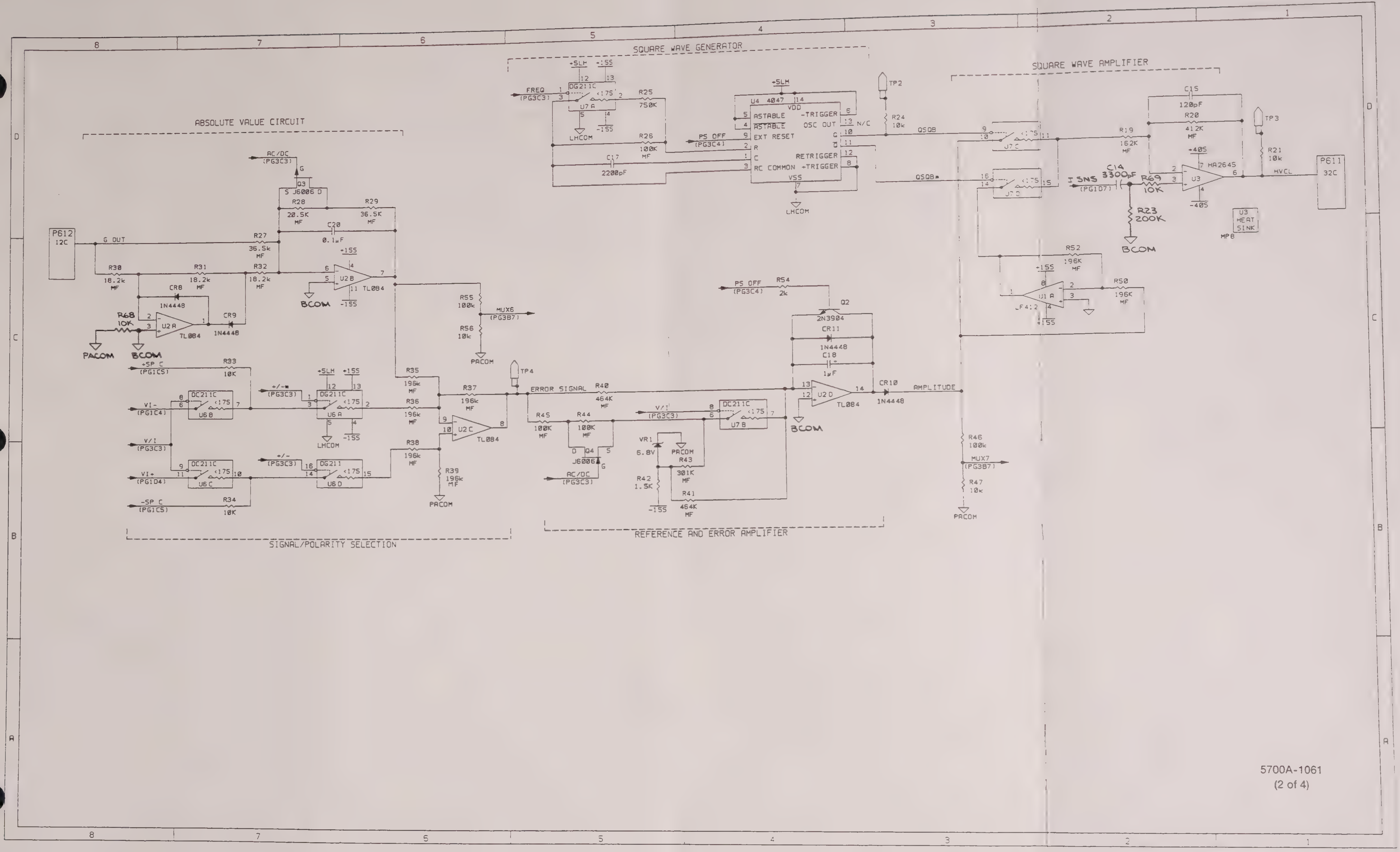

Figure 7-17. A14 High Voltage Control PCA (cont)

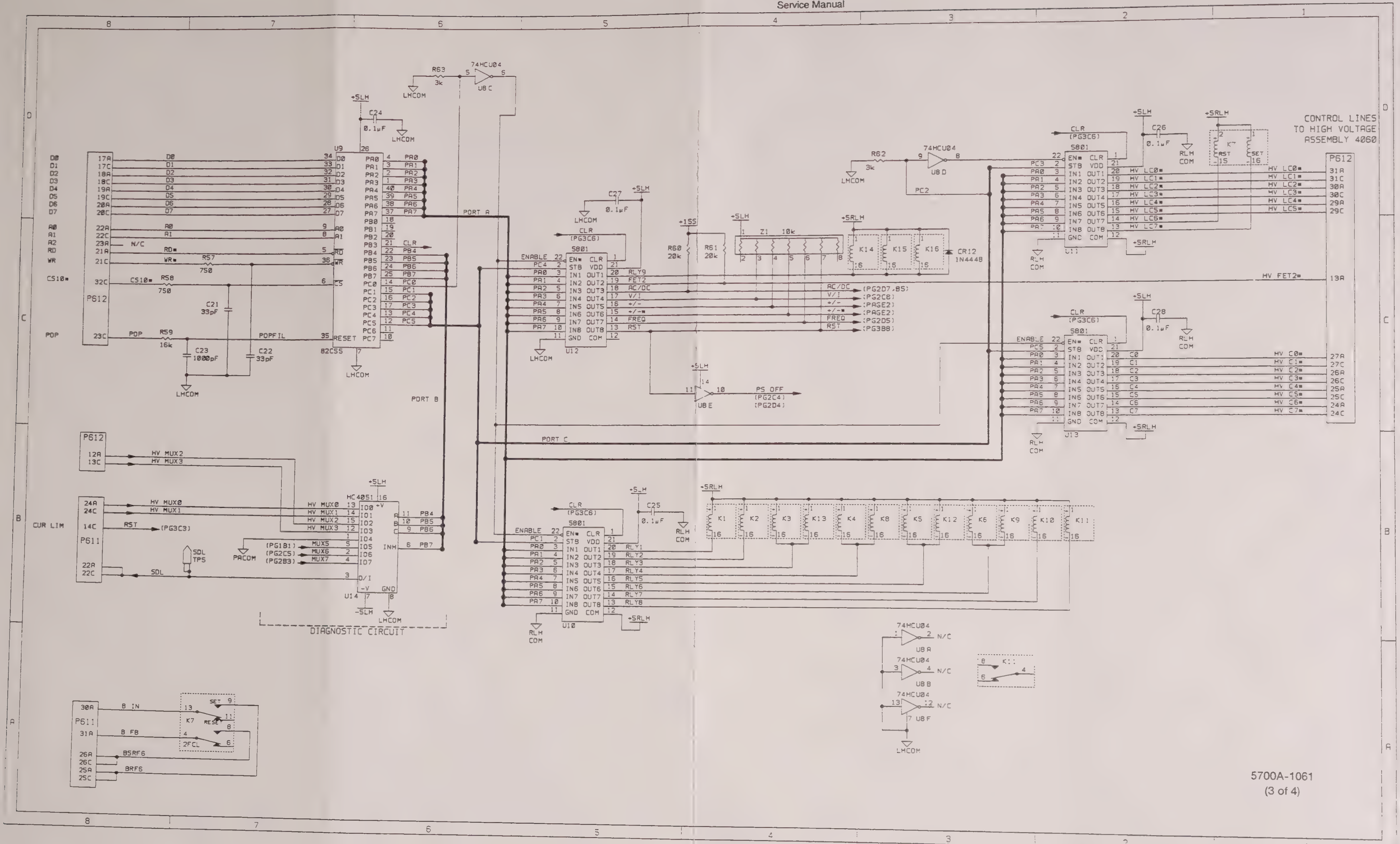

Figure 7-17. A14 High Voltage Control PCA (cont)

HIGH VOLTAGE A15 ASSEMBLY

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K14	Q10
DORMANT	R	R	R											*
AC 220V RANGE	R	R	R											*
DC 220V RANGE	R	R	R											*
AC 1100V RANGE	R	R	R	*		*								*
DC +1100V RANGE	S	R	S		*	*	*						*	*
DC -1100V RANGE	S	R	S		*	*	*						*	*
AC 2.2A RANGE	R	R	R								*	*		
DC +2.2A RANGE	R	R	R								*	*		
DC -2.2A RANGE	R	R	R								*	*		
OFFSET CAL HR7 RNET	S	R	S		*		*		*				*	*
GAIN CAL HR7 RNET	R	S	S					*						*
AC 220V AC FREQ CHAR	R	R	R								*	*		*
AC 1100V AC FREQ CHAR	R	R	R	*		*		*		*	*	*		*
OFFSET CAL CURRENT RNET	R	R	R								*	*		
GAIN CAL CURRENT RNET	R	R	R								*	*		

HIGH VOLTAGE CONTROL A14 ASSEMBLY

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	Q3	Q4	U6A	U6B	U6C	U6D	U7A	U7B
DORMANT							R												*					
AC 220V RANGE							R			*									*					
DC 220V RANGE							R												*					
AC 1100V RANGE	*		*				R						*	1	1	1			*					
DC +1100V RANGE	*		*		*	*	R		*		*	*	*						*					
DC -1100V RANGE	*		*	*	*	*	R	*	*			*	*									*		
AC 2.2A RANGE	*	*			*		R					*					*	*		*	*	*		*
DC +2.2A RANGE	*	*			*		R					*								*	*	*		*
DC -2.2A RANGE	*	*			*		R					*							*	*	*			*
OFFSET CAL HR7 RNET							R												*					
GAIN CAL HR7 RNET							R												*					
AC 220V AC FREQ CHAR							R			*									*					
AC 1100V AC FREQ CHAR	*		*				R						*						*					
OFFSET CAL CURRENT RNET	*	*			*		R					*								*	*	*		*
GAIN CAL CURRENT RNET	*	*			*		R					*								*	*	*		*

R = RESET POSITION FOR LATCHING RELAYS
S = SET POSITION FOR LATCHING RELAYS
* = ENERGIZED FOR NON-LATCHING RELAYS
* = ON FOR FETS
1 = ENERGIZED DURING OPERATION BELOW 120Hz ONLY
RELAY K7 IS SET DURING CALIBRATION OF THE 1.9 OHM ON THE OHMS CAL ASSEMBLY

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Figure 7-17. A14 High Voltage Control PCA (cont)

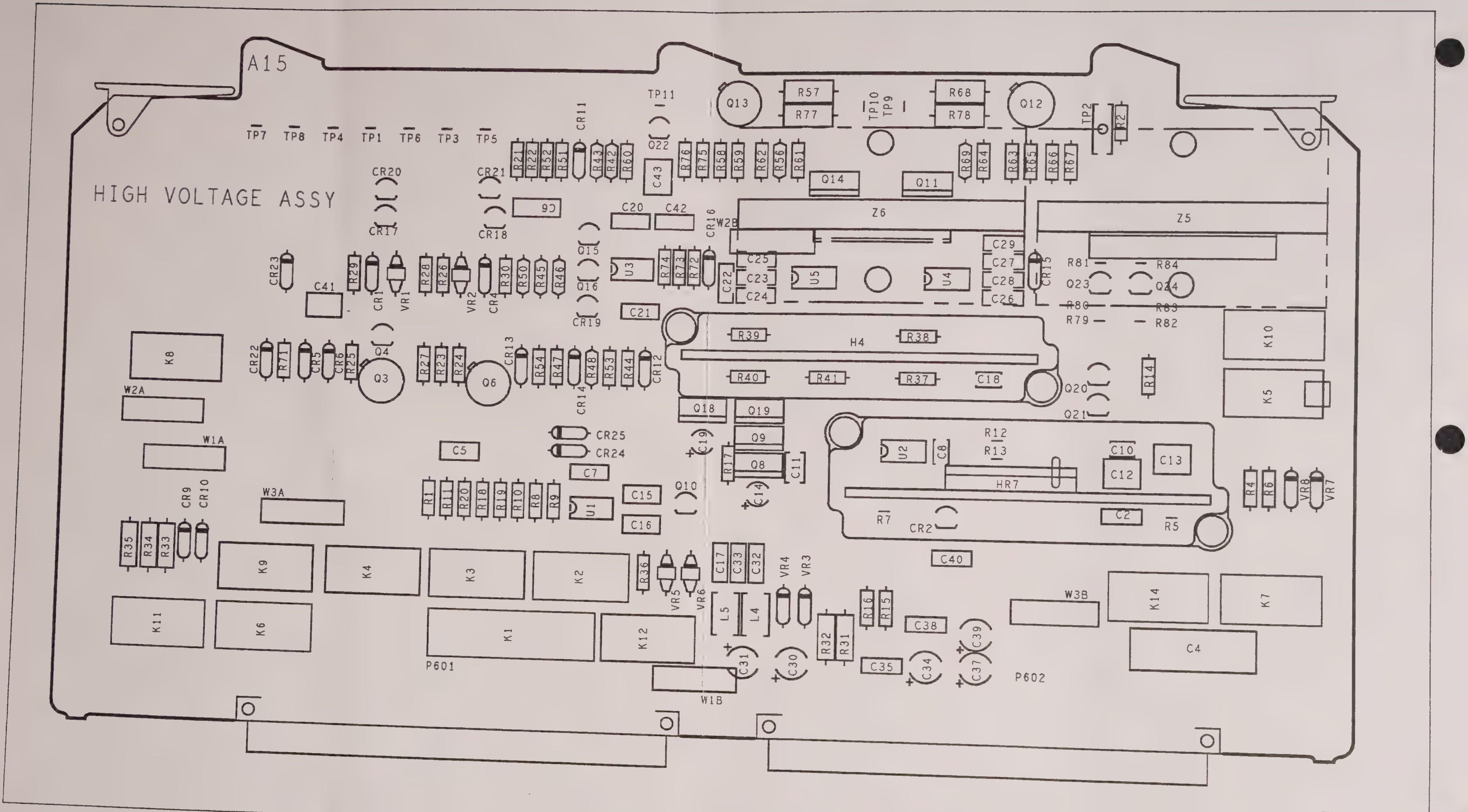

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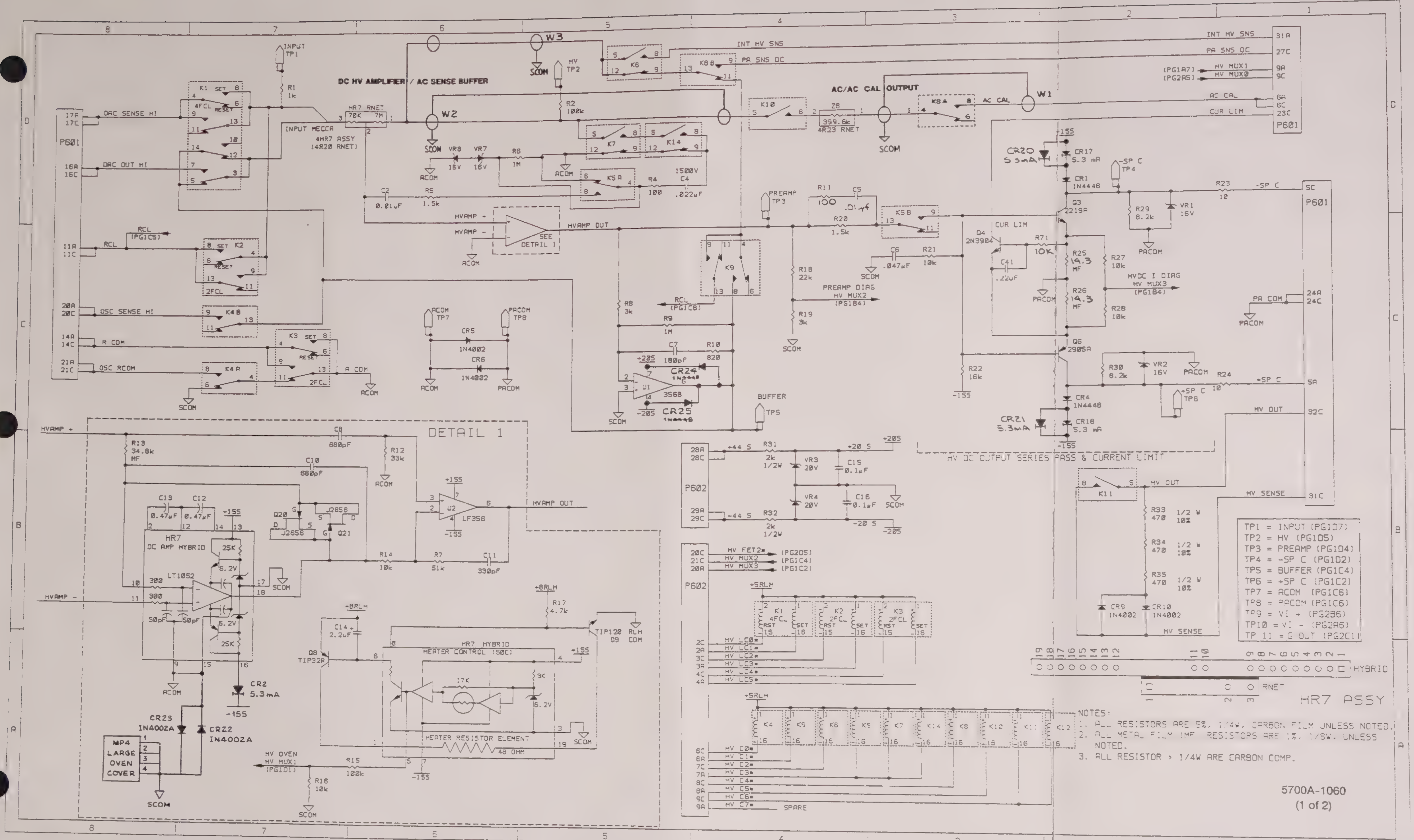
Figure 7-18. A15 High Voltage/High Current PCA



TP1 = INPUT (PG1D7)
TP2 = HV (PG1D5)
TP3 = PREAMP (PG1D4)
TP4 = -SP C (PG1D2)
TP5 = BUFFER (PG1C4)
TP6 = +SP C (PG1C2)
TP7 = ACOM (PG1C6)
TP8 = PACOM (PG1C6)
TP9 = VI + (PG2B6)
TP10 = VI - (PG2A6)
TP 11 = G OUT (PG2C1)

NOTES:

1. ALL RESISTORS ARE 5%, 1/4W, CARBON FILM UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W, UNLESS NOTED.
3. ALL RESISTOR > 1/4W ARE CARBON COMP.

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Figure 7-18. A15 High Voltage/High Current PCA (cont)

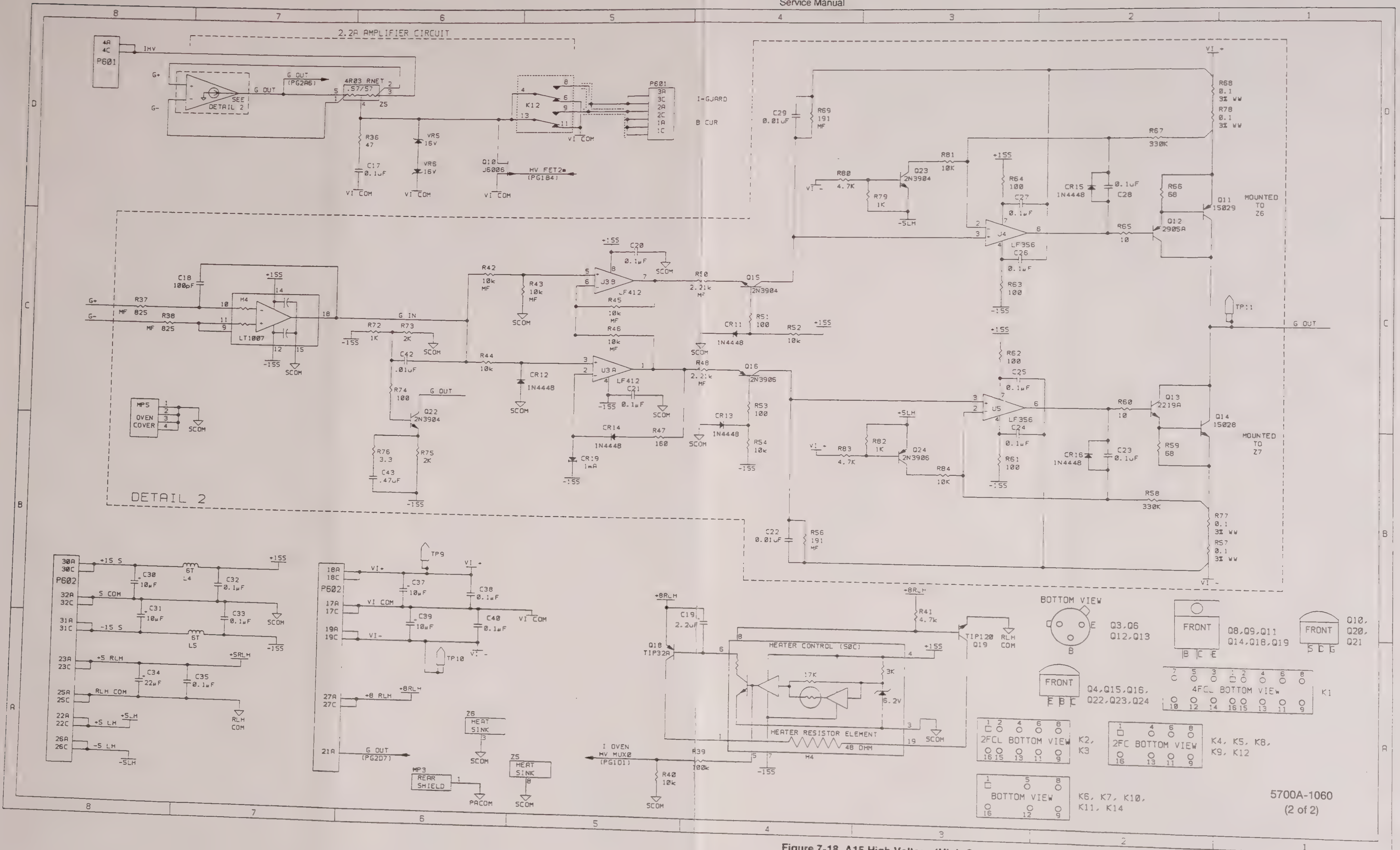


Figure 7-18. A15 High Voltage/High Current PCA (cont)

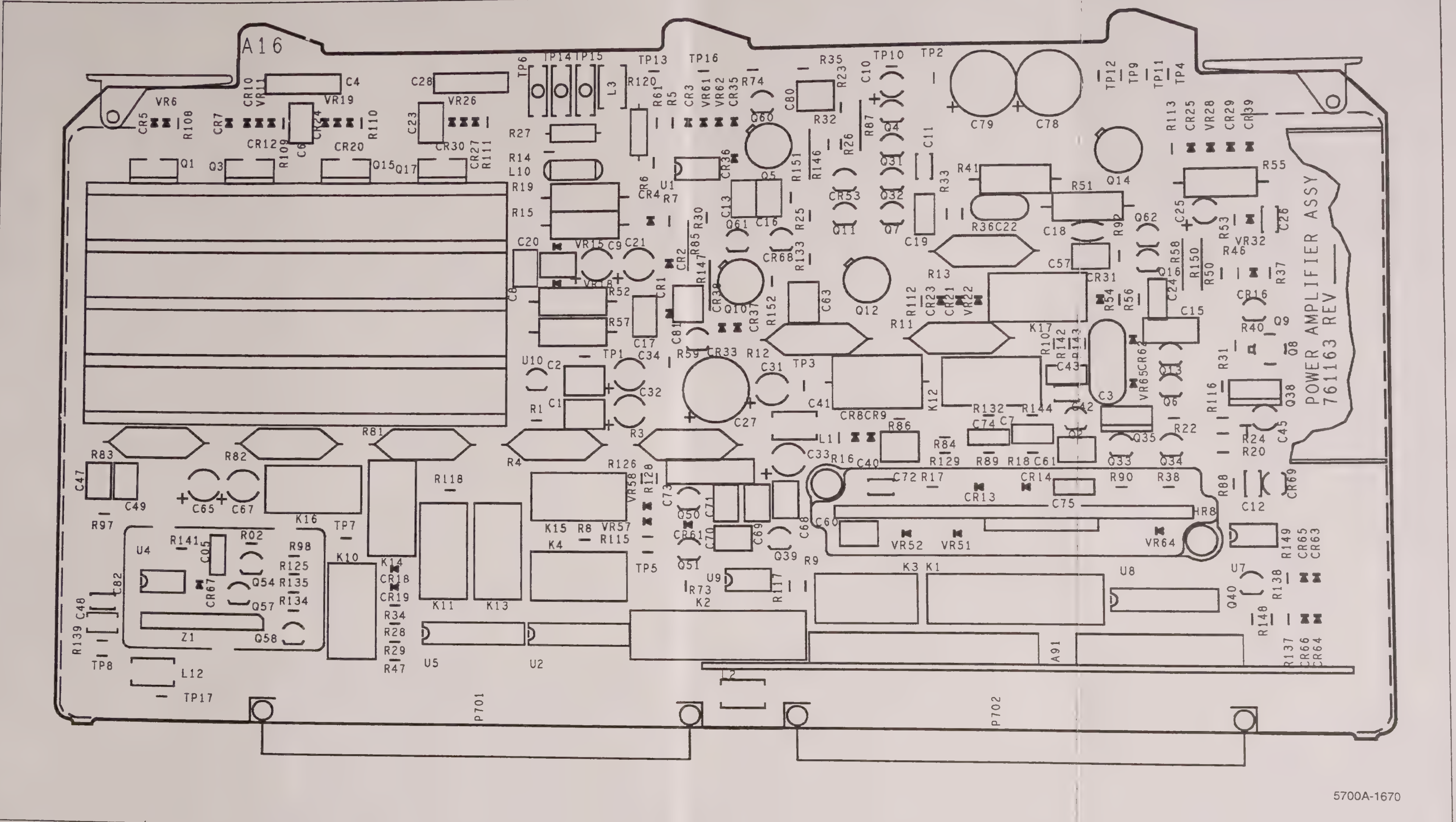
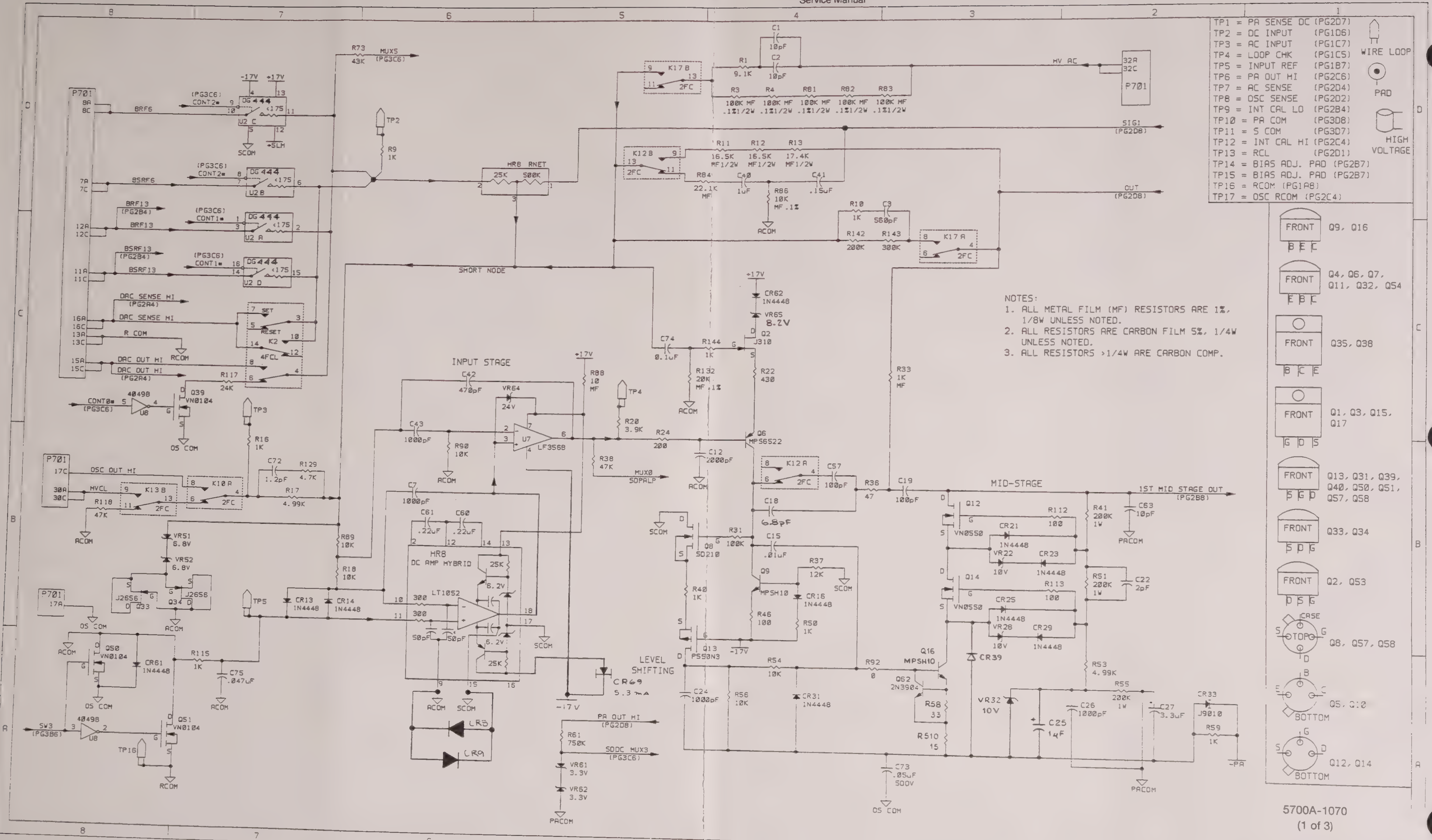


Figure 7-19. A16 Power Amplifier PCA



TP1 = PA SENSE DC (PG2D7)
TP2 = DC INPUT (PG1D6)
TP3 = AC INPUT (PG1C7)
TP4 = LOOP CHK (PG1C5)
TP5 = INPUT REF (PG1B7)
TP6 = PA OUT HI (PG2C6)
TP7 = AC SENSE (PG2D4)
TP8 = OSC SENSE (PG2D2)
TP9 = INT CAL LO (PG2B4)
TP10 = PA COM (PG3D8)
TP11 = S COM (PG3D7)
TP12 = INT CAL HI (PG2C4)
TP13 = RCL (PG2D1)
TP14 = BIAS ADJ. PAD (PG2B7)
TP15 = BIAS ADJ. PAD (PG2B7)
TP16 = RCOM (PG1A8)
TP17 = OSC RCOM (PG2C4)

NOTES:

1. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.
2. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
3. ALL RESISTORS >1/4W ARE CARBON COMP.

Figure 7-19. A16 Power Amplifier PCA (cont)

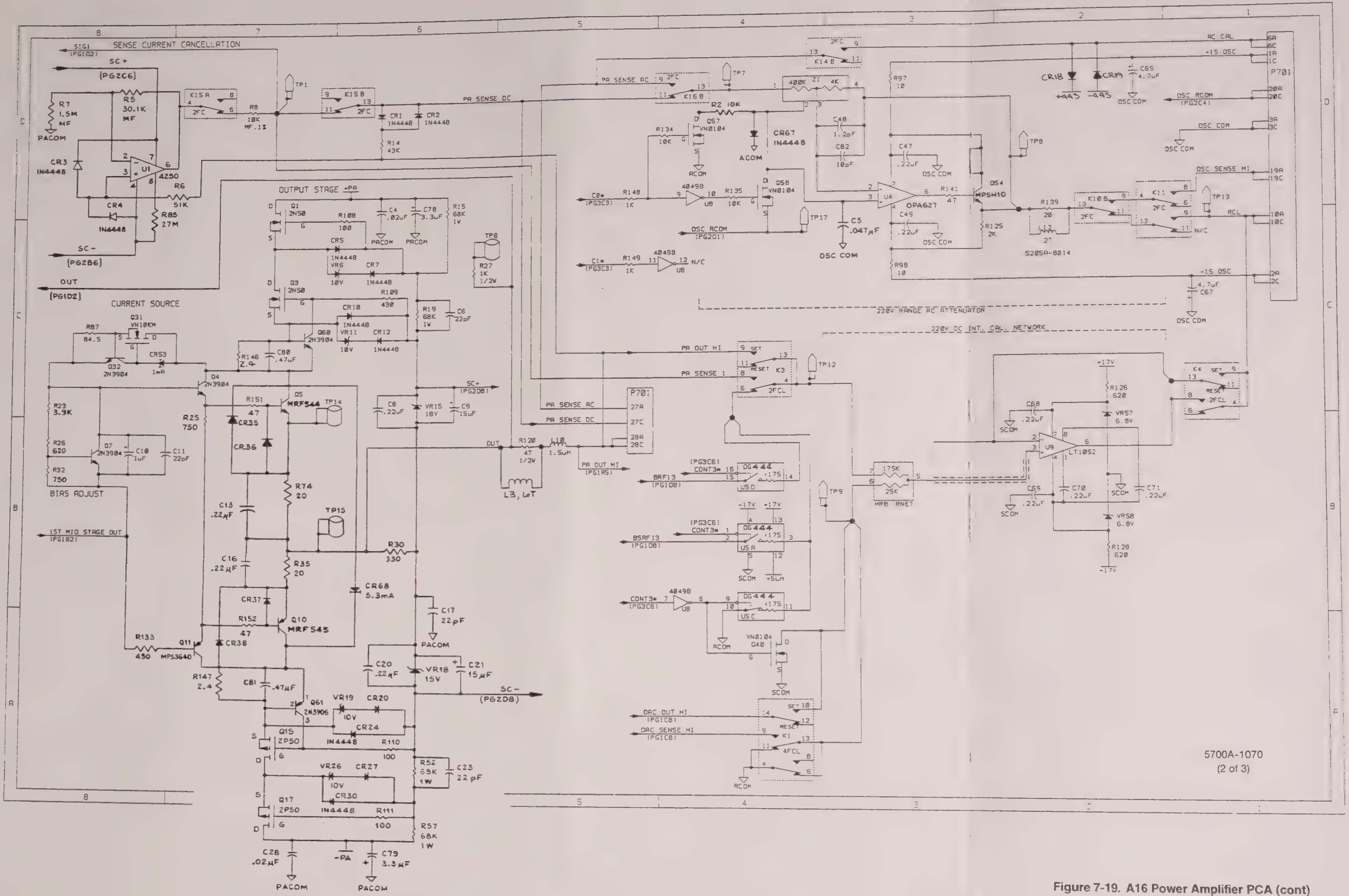
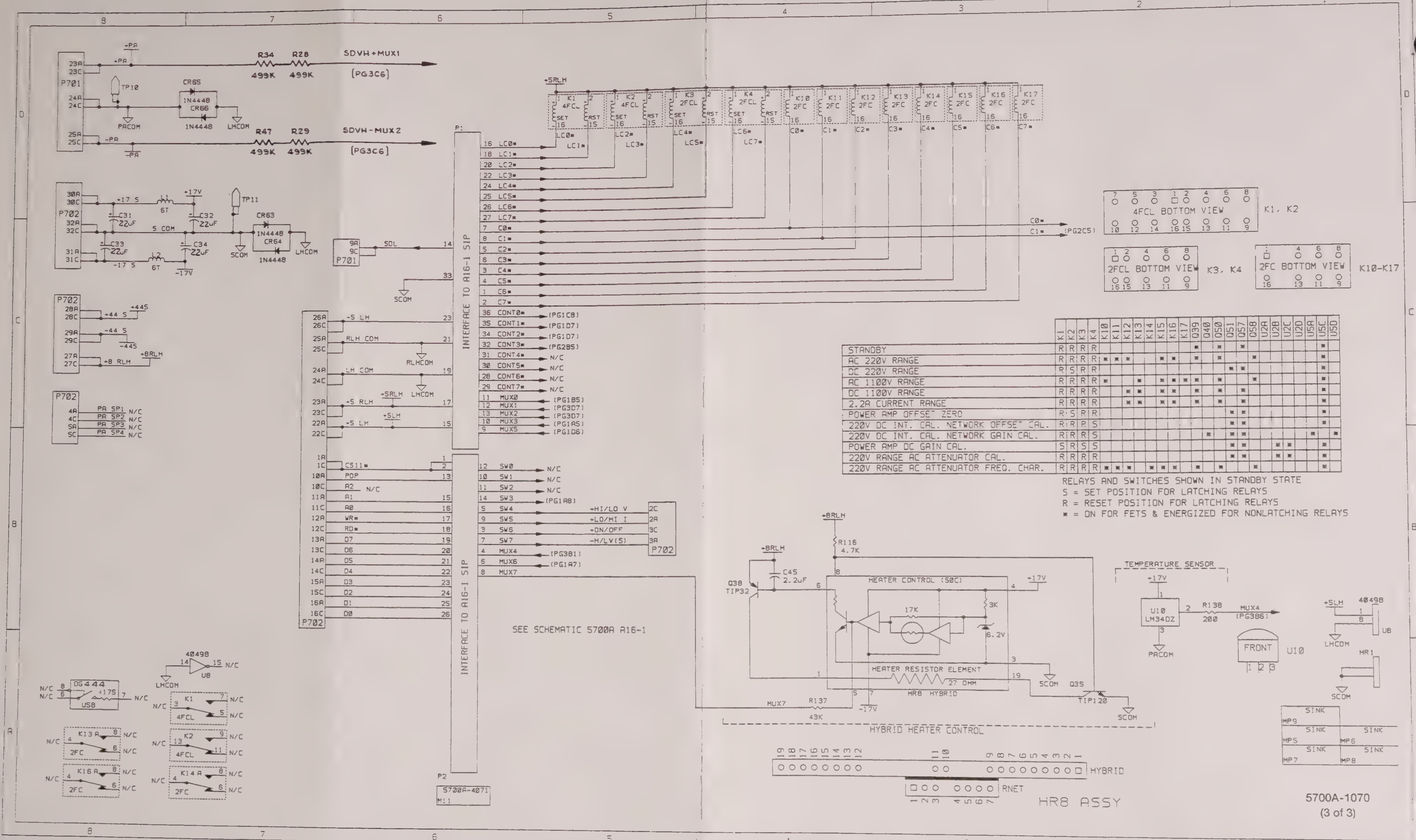


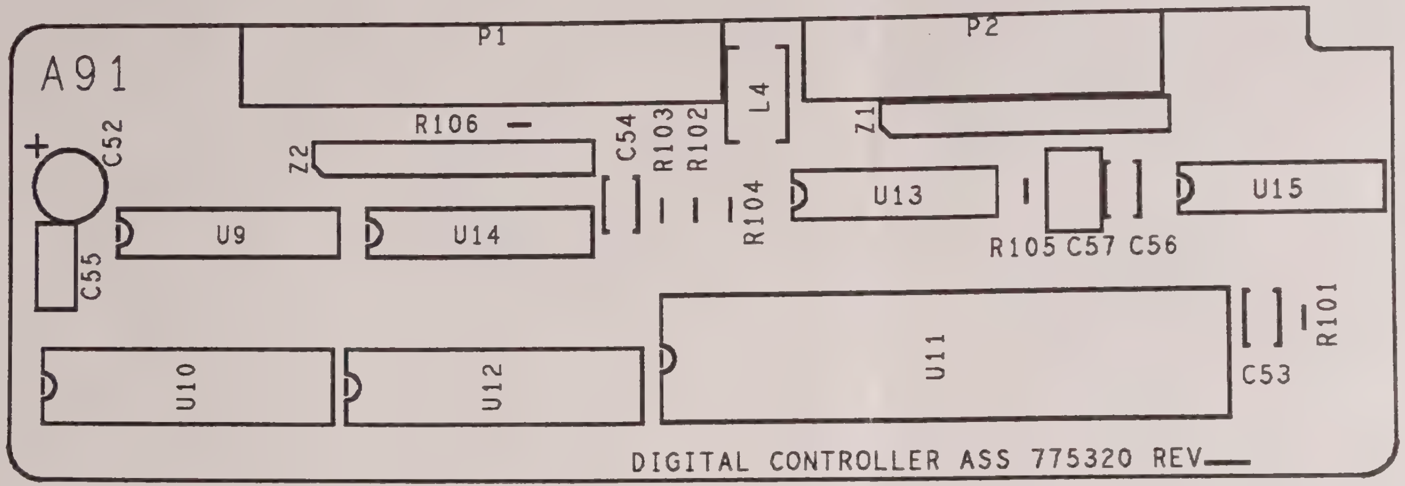
Figure 7-19. A16 Power Amplifier PCA (cont)



	K1	K2	K3	K4	K10	K11	K12	K13	K14	K15	K16	K17	Q39	Q40	Q50	Q51	Q57	Q58	U2A	U2B	U2C	U2D	U5A	U5C	U5D
STANDBY	R	R	R	R									*		*		*							*	
AC 220V RANGE	R	R	R	R	*	*	*			*	*		*		*			*						*	
DC 220V RANGE	R	S	R	R												*	*							*	
AC 1100V RANGE	R	R	R	R	*			*		*	*	*	*		*			*						*	
DC 1100V RANGE	R	R	R	R			*	*		*	*		*		*		*							*	
2.2A CURRENT RANGE	R	R	R	R			*	*		*	*		*		*		*							*	
POWER AMP OFFSET ZERO	R	S	R	R												*	*							*	
220V DC INT. CAL. NETWORK OFFSET CAL.	R	R	R	S												*	*							*	
220V DC INT. CAL. NETWORK GAIN CAL.	R	R	R	S										*		*	*						*		*
POWER AMP DC GAIN CAL.	S	R	S	S												*	*			*	*			*	
220V RANGE AC ATTENUATOR CAL.	R	R	R	R												*	*			*	*			*	
220V RANGE AC ATTENUATOR FREQ. CHAR.	R	R	R	R	*	*	*		*	*	*		*		*			*						*	

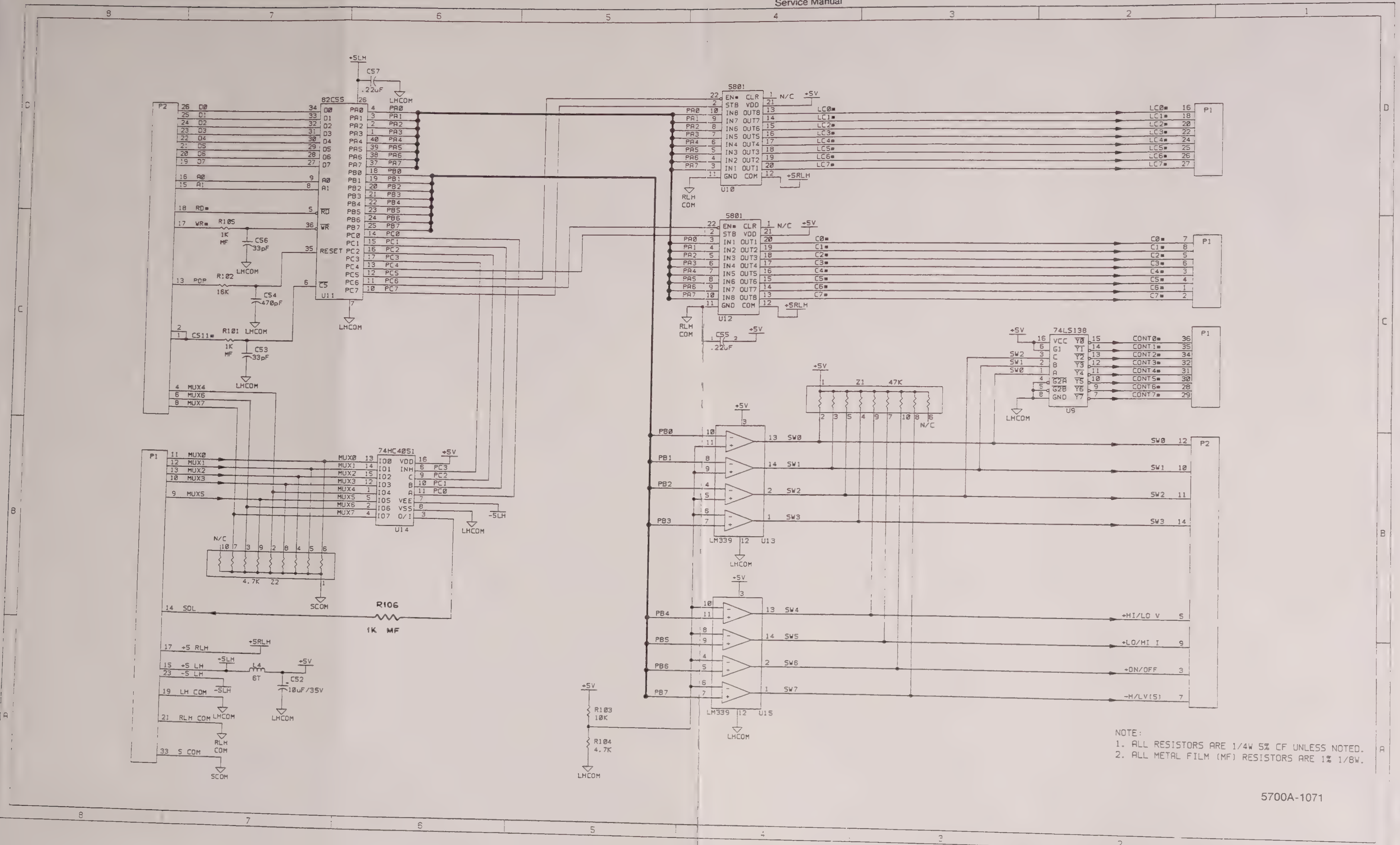
RELAYS AND SWITCHES SHOWN IN STANDBY STATE
S = SET POSITION FOR LATCHING RELAYS
R = RESET POSITION FOR LATCHING RELAYS
* = ON FOR FETS & ENERGIZED FOR NONLATCHING RELAYS

Figure 7-19. A16 Power Amplifier PCA (cont)



5700A-1671

Figure 7-20. A16A1 Power Amplifier Digital Control SIP PCA



NOTE:
1. ALL RESISTORS ARE 1/4W 5% CF UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1% 1/8W.

5700A-1071

Figure 7-20. A16A1 Power Amplifier Digital Control SIP PCA (cont)

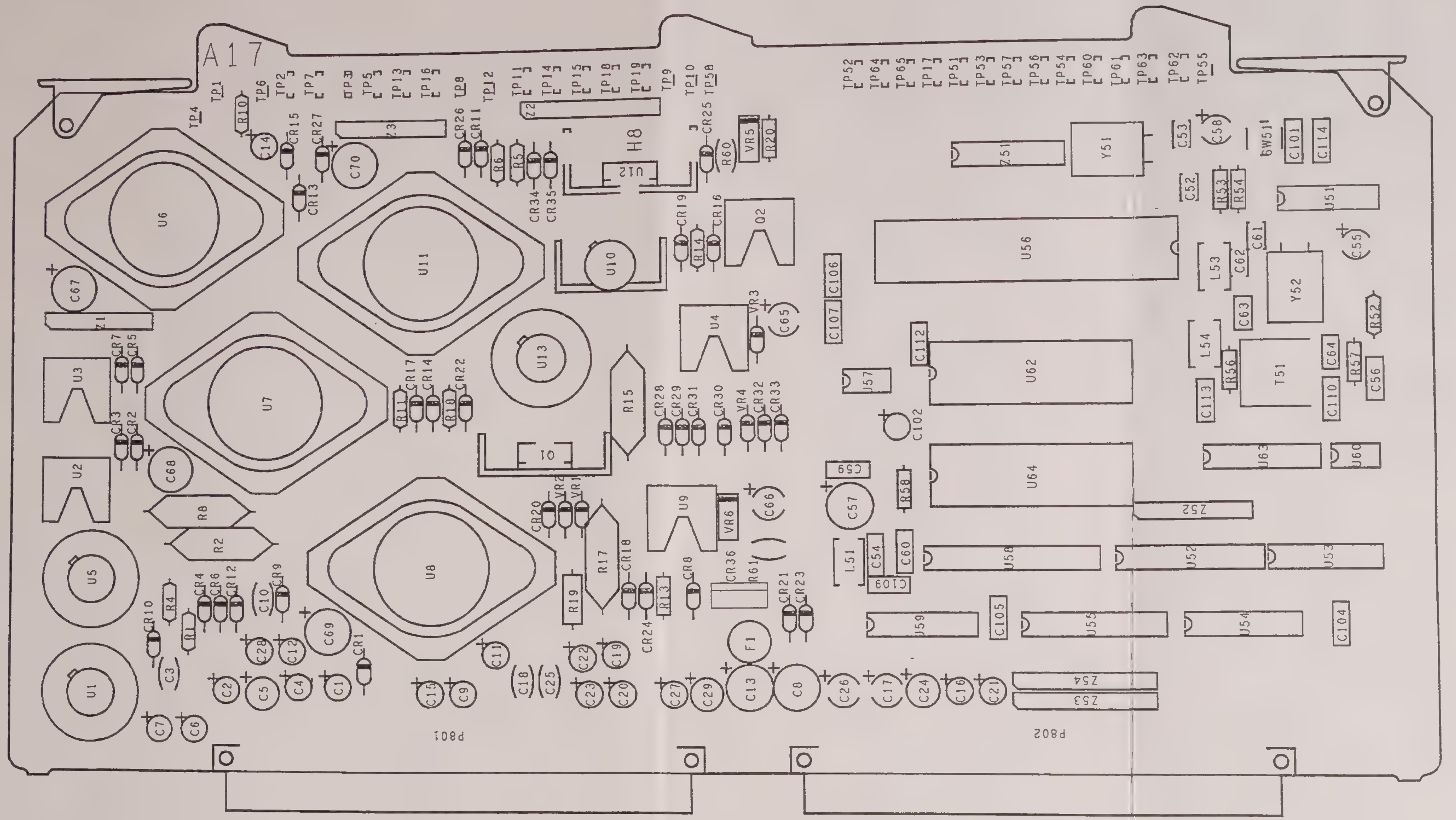


Figure 7-21. A17 Regulator/Guard Crossing PCA

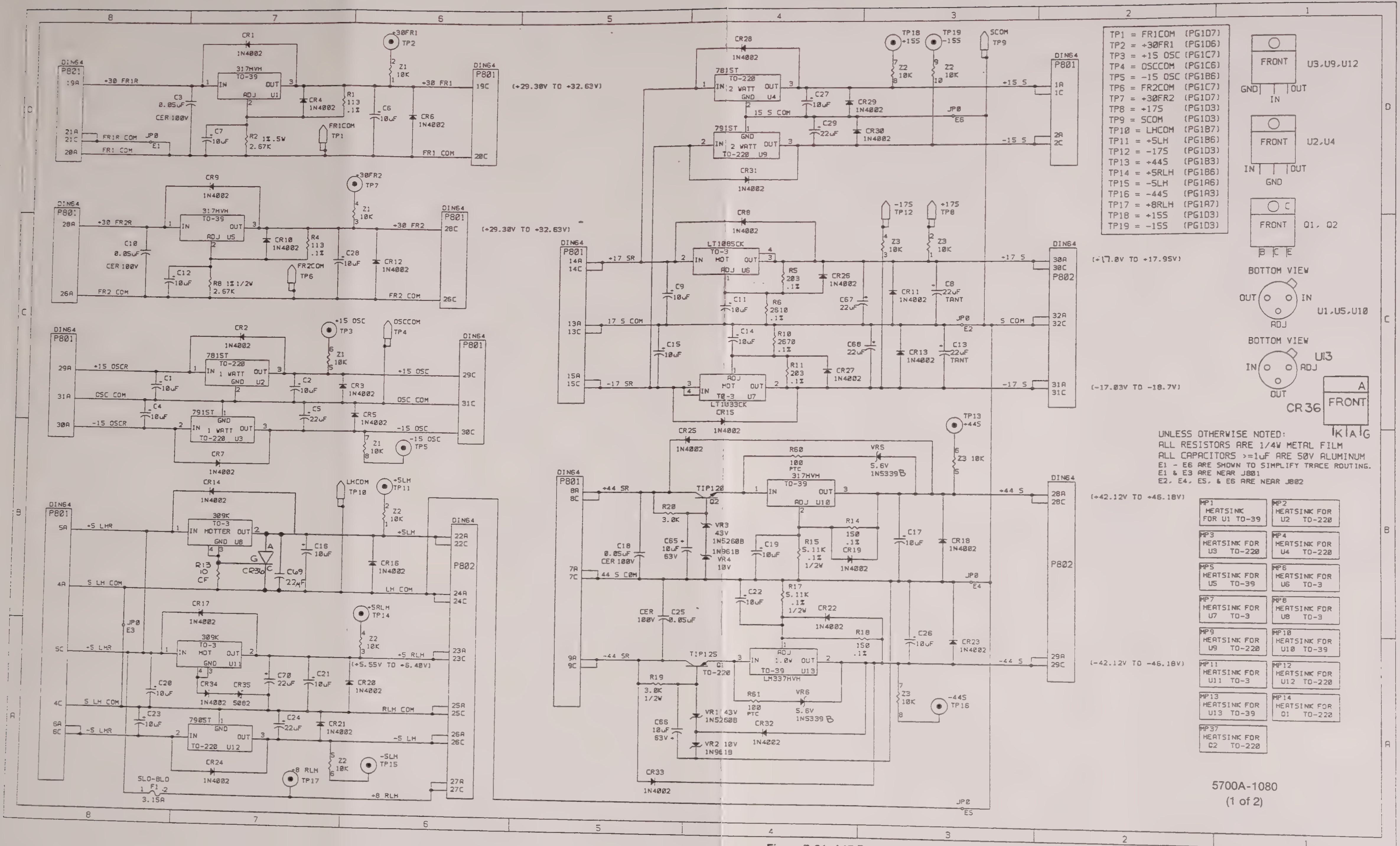
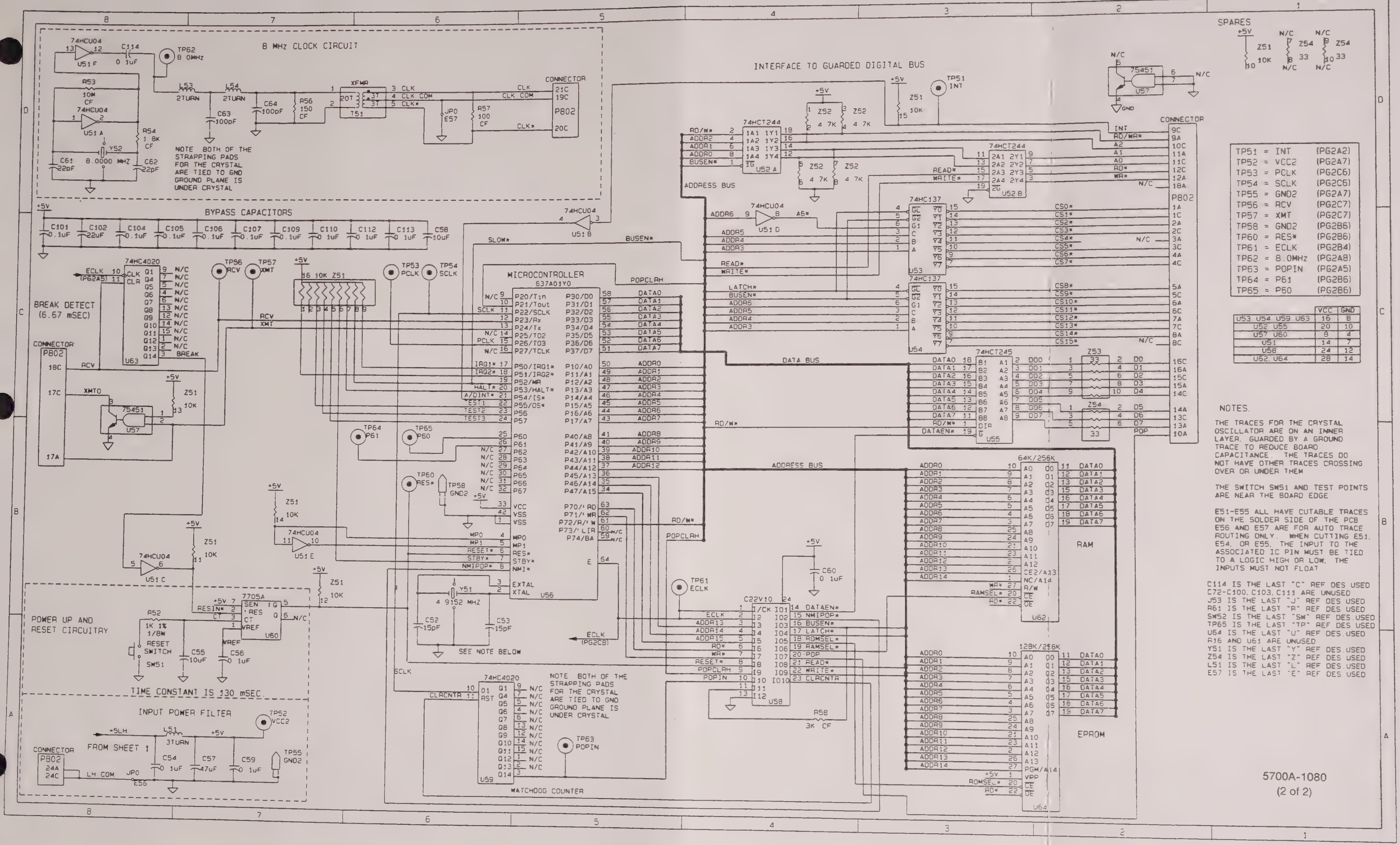


Figure 7-21. A17 Regulator/Guard Crossing PCA (cont)


8 MHz CLOCK CIRCUIT
NOTE BOTH OF THE STRAPPING PADS FOR THE CRYSTAL ARE TIED TO GND GROUND PLANE IS UNDER CRYSTAL
BYPASS CAPACITORS
BREAK DETECT (6.67 mSEC)
MICROCONTROLLER 637A01Y0
INTERFACE TO GUARDED DIGITAL BUS
ADDRESS BUS
DATA BUS
CONNECTOR P802
SPARES
POWER UP AND RESET CIRCUITRY
TIME CONSTANT IS 130 mSEC
INPUT POWER FILTER
FROM SHEET 1
SEE NOTE BELOW
NOTE BOTH OF THE STRAPPING PADS FOR THE CRYSTAL ARE TIED TO GND GROUND PLANE IS UNDER CRYSTAL
WATCHDOG COUNTER
RAM
EPROM
5700A-1080
(2 of 2)

TP51 = INT (PG2A2)
TP52 = VCC2 (PG2A7)
TP53 = PCLK (PG2C6)
TP54 = SCLK (PG2C6)
TP55 = GND2 (PG2A7)
TP56 = RCV (PG2C7)
TP57 = XMT (PG2C7)
TP58 = GND2 (PG2B6)
TP60 = RES* (PG2B6)
TP61 = ECLK (PG2B4)
TP62 = 8.0MHz (PG2A8)
TP63 = POPIN (PG2A5)
TP64 = P61 (PG2B6)
TP65 = P60 (PG2B6)

	VCC	GND
U53 U54 U59 U63	16	8
U52 U55	20	10
U57 U60	8	4
U51	14	7
U58	24	12
U62. U64	28	14

NOTES.

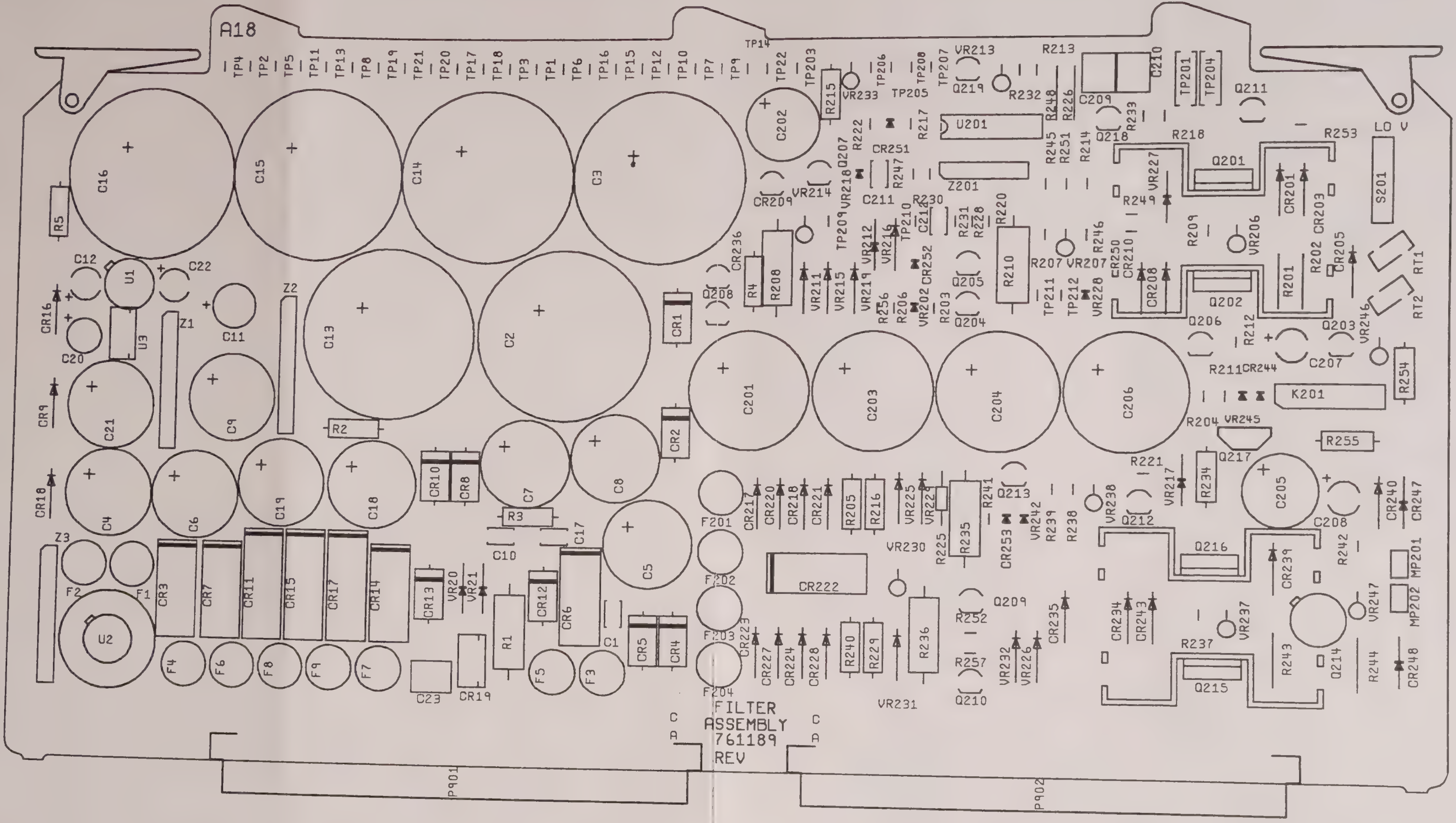
THE TRACES FOR THE CRYSTAL OSCILLATOR ARE ON AN INNER LAYER. GUARDED BY A GROUND TRACE TO REDUCE BOARD CAPACITANCE. THE TRACES DO NOT HAVE OTHER TRACES CROSSING OVER OR UNDER THEM

THE SWITCH SW51 AND TEST POINTS ARE NEAR THE BOARD EDGE

E51-E55 ALL HAVE CUTABLE TRACES ON THE SOLDER SIDE OF THE PCB E56 AND E57 ARE FOR AUTO TRACE ROUTING ONLY. WHEN CUTTING E51. E54. OR E55. THE INPUT TO THE ASSOCIATED IC PIN MUST BE TIED TO A LOGIC HIGH OR LOW: THE INPUTS MUST NOT FLOAT

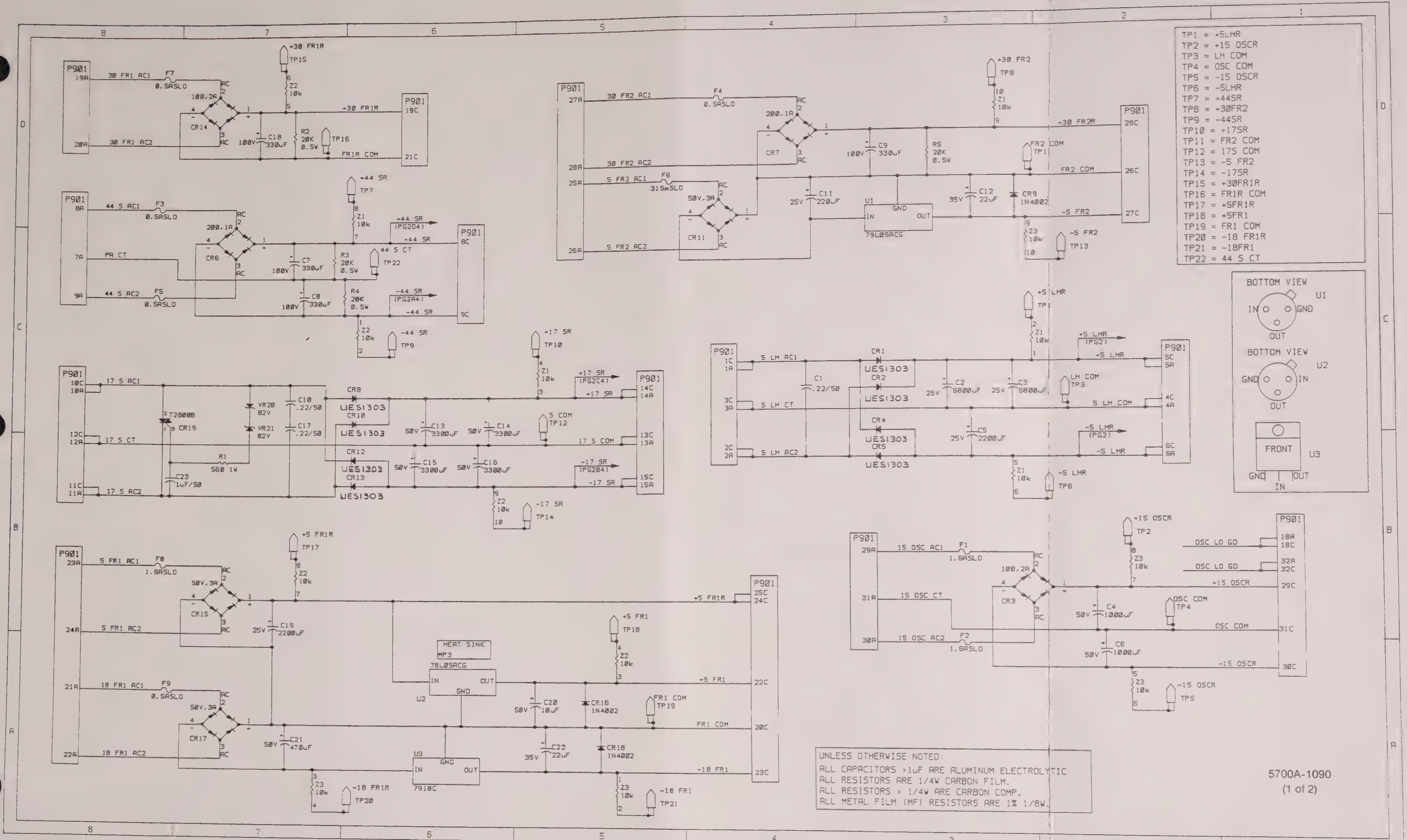
C114 IS THE LAST "C" REF DES USED
C72-C100. C103. C111 ARE UNUSED
J53 IS THE LAST "J" REF DES USED
R61 IS THE LAST "R" REF DES USED
SW52 IS THE LAST "SW" REF DES USED
TP65 IS THE LAST "TP" REF DES USED
U64 IS THE LAST "U" REF DES USED
R16 AND U61 ARE UNUSED
Y51 IS THE LAST "Y" REF DES USED
Z54 IS THE LAST "Z" REF DES USED
L51 IS THE LAST "L" REF DES USED
E57 IS THE LAST "E" REF DES USED

Figure 7-21. A17 Regulator/Guard Crossing PCA (cont)



5700A-1690

Figure 7-22. A18 Filter/PA Supply PCA



TP1 = +5LHR
TP2 = +15 OSCR
TP3 = LH COM
TP4 = OSC COM
TP5 = -15 OSCR
TP6 = -5LHR
TP7 = +44SR
TP8 = +30FR2
TP9 = -44SR
TP10 = +17SR
TP11 = FR2 COM
TP12 = 17S COM
TP13 = -5 FR2
TP14 = -17SR
TP15 = +30FR1R
TP16 = FR1R COM
TP17 = +5FR1R
TP18 = +5FR1
TP19 = FR1 COM
TP20 = -18 FR1R
TP21 = -18FR1
TP22 = 44 S CT

UNLESS OTHERWISE NOTED:
ALL CAPACITORS >1uF ARE ALUMINUM ELECTROLYTIC
ALL RESISTORS ARE 1/4W CARBON FILM.
ALL RESISTORS > 1/4W ARE CARBON COMP.
ALL METAL FILM (MF) RESISTORS ARE 1% 1/8W.

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Figure 7-22. A18 Filter/PA Supply PCA (cont)

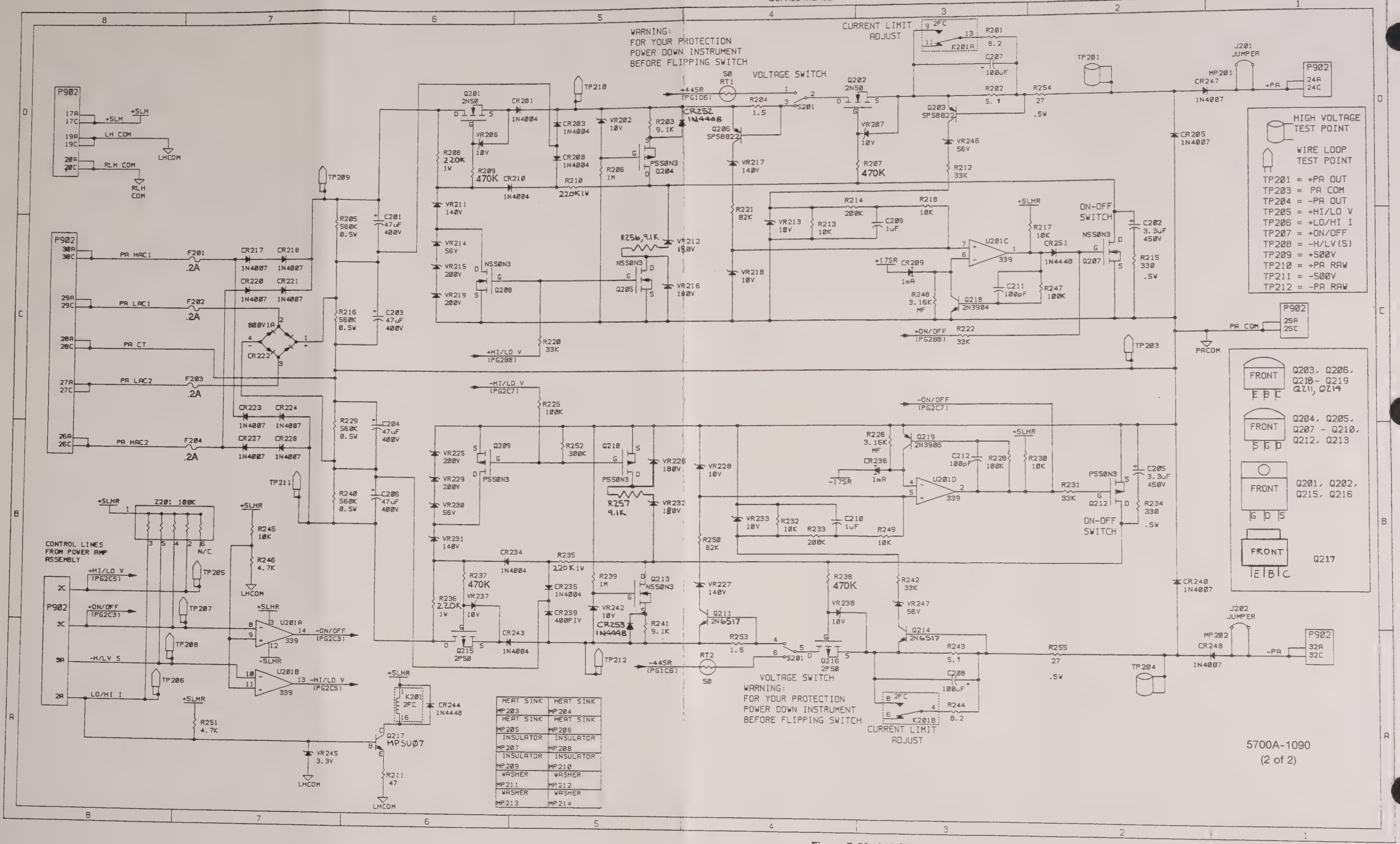
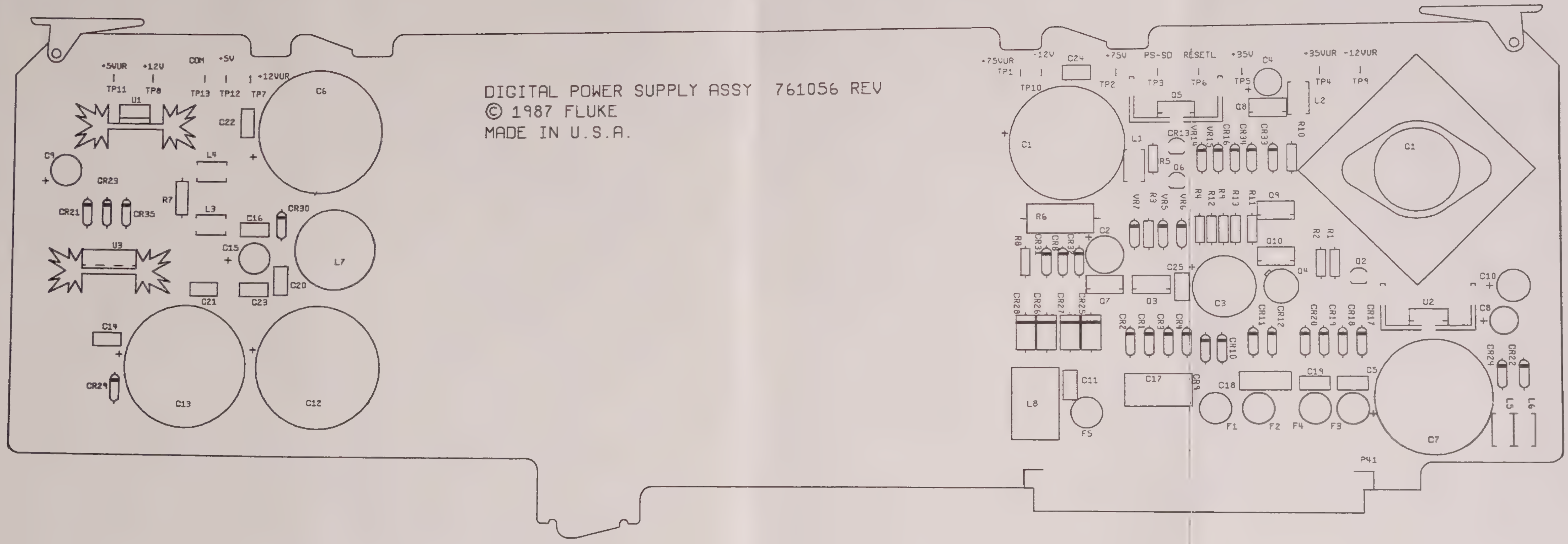


Figure 7-22. A18 Filter/PA Supply PCA (cont)



5700A-1604

Figure 7-23. A19 Digital Power Supply PCA

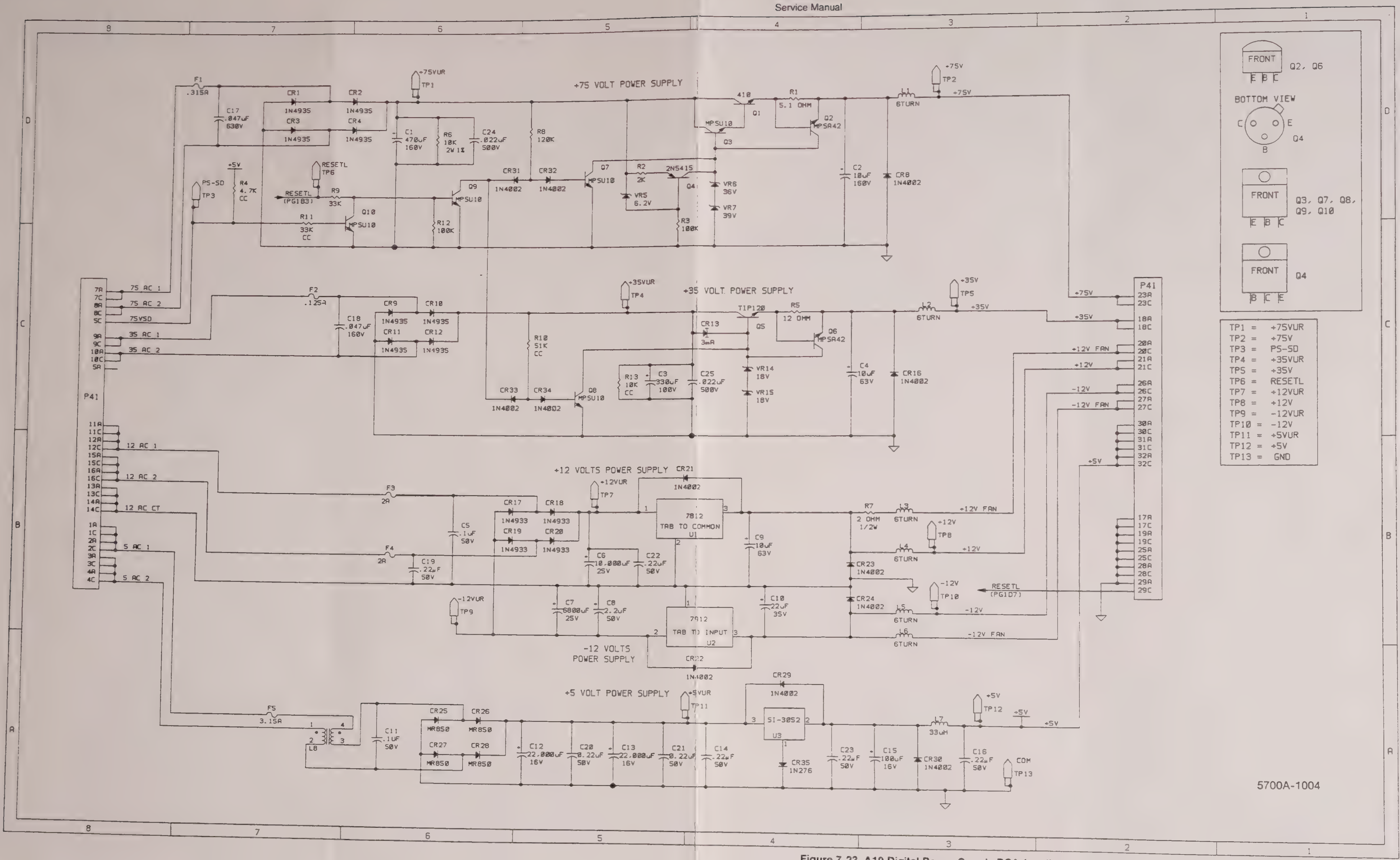


Figure 7-23. A19 Digital Power Supply PCA (cont)

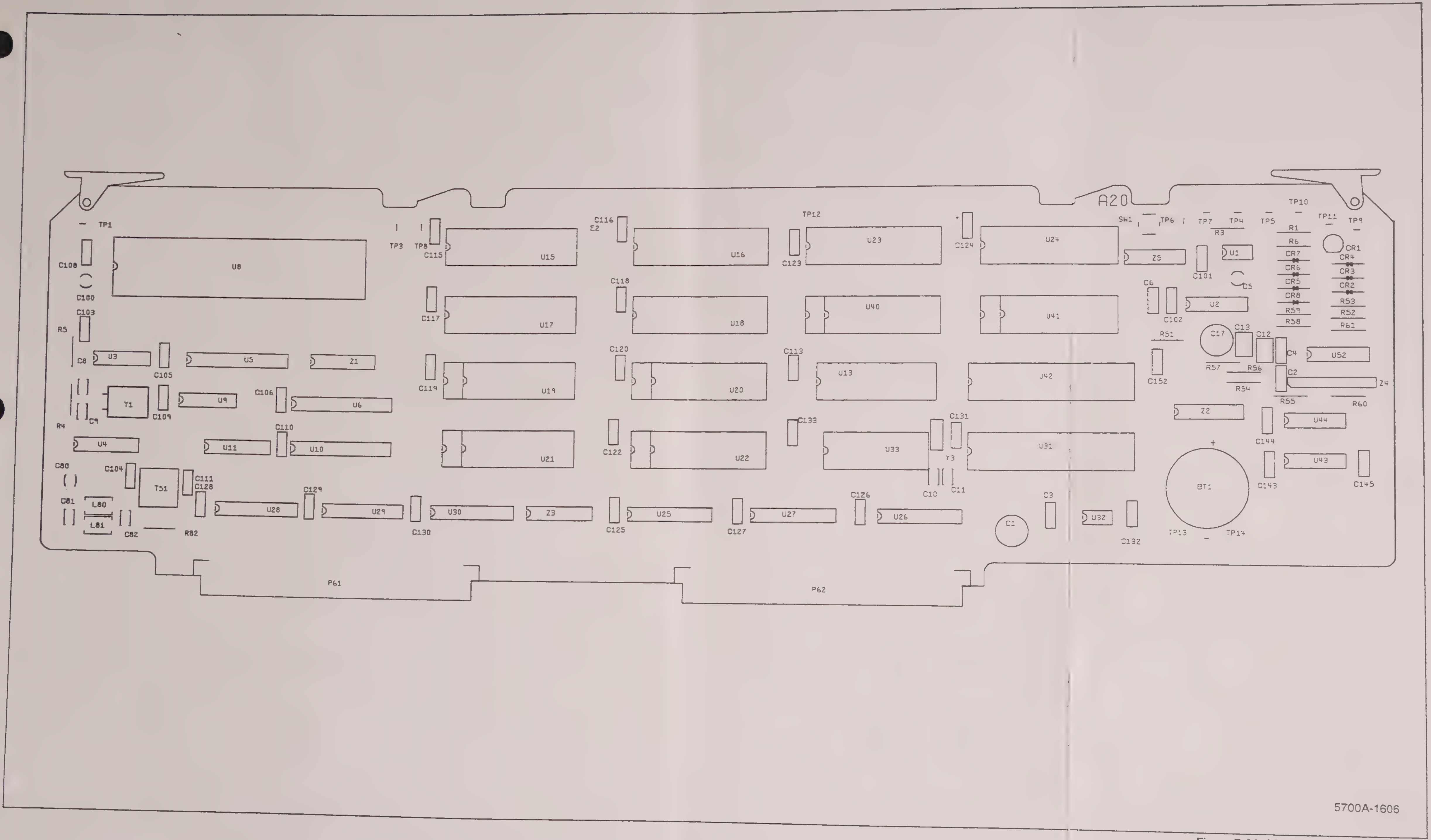


Figure 7-24. A20 CPU PCA

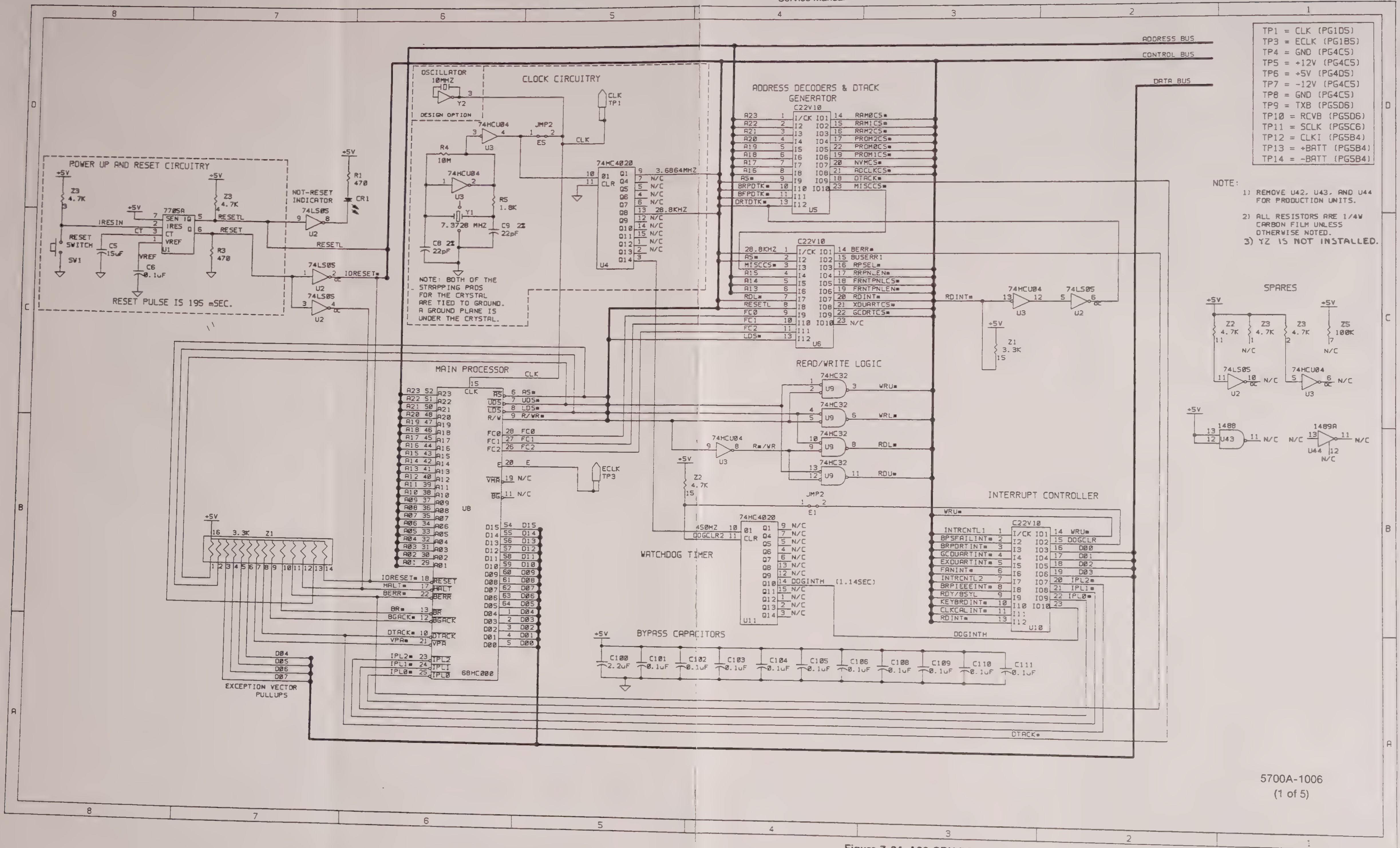


Figure 7-24. A20 CPU PCA (cont)

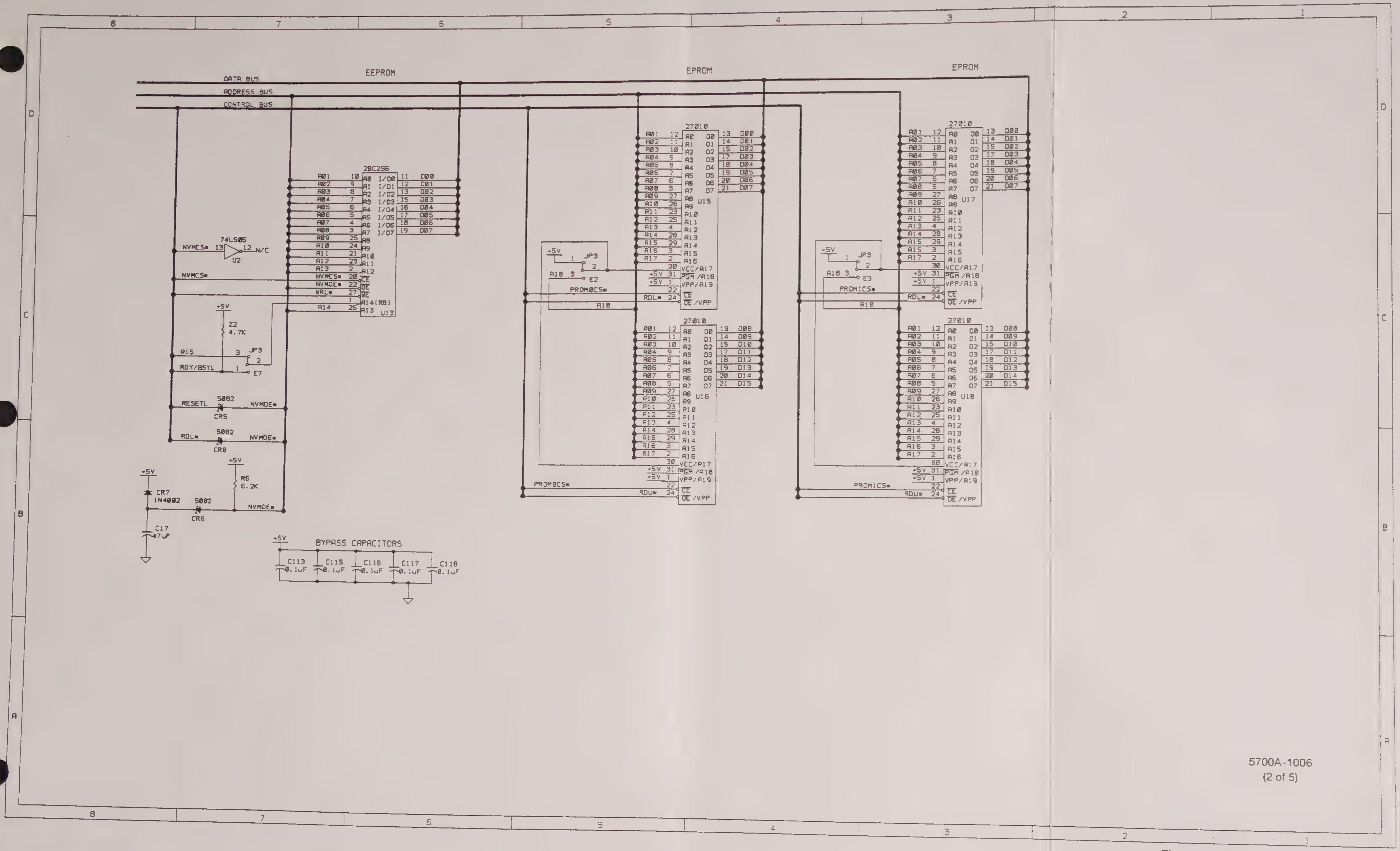
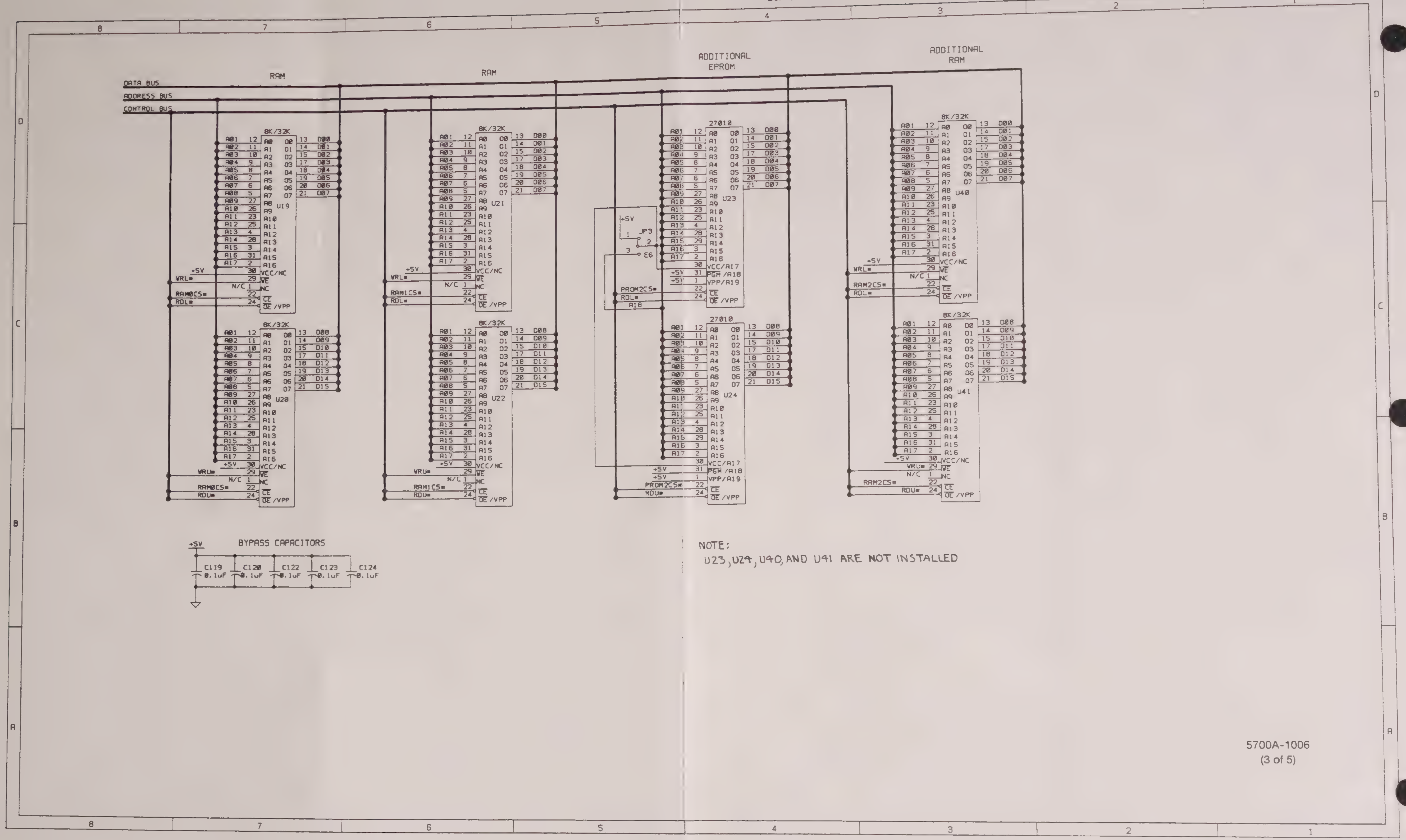
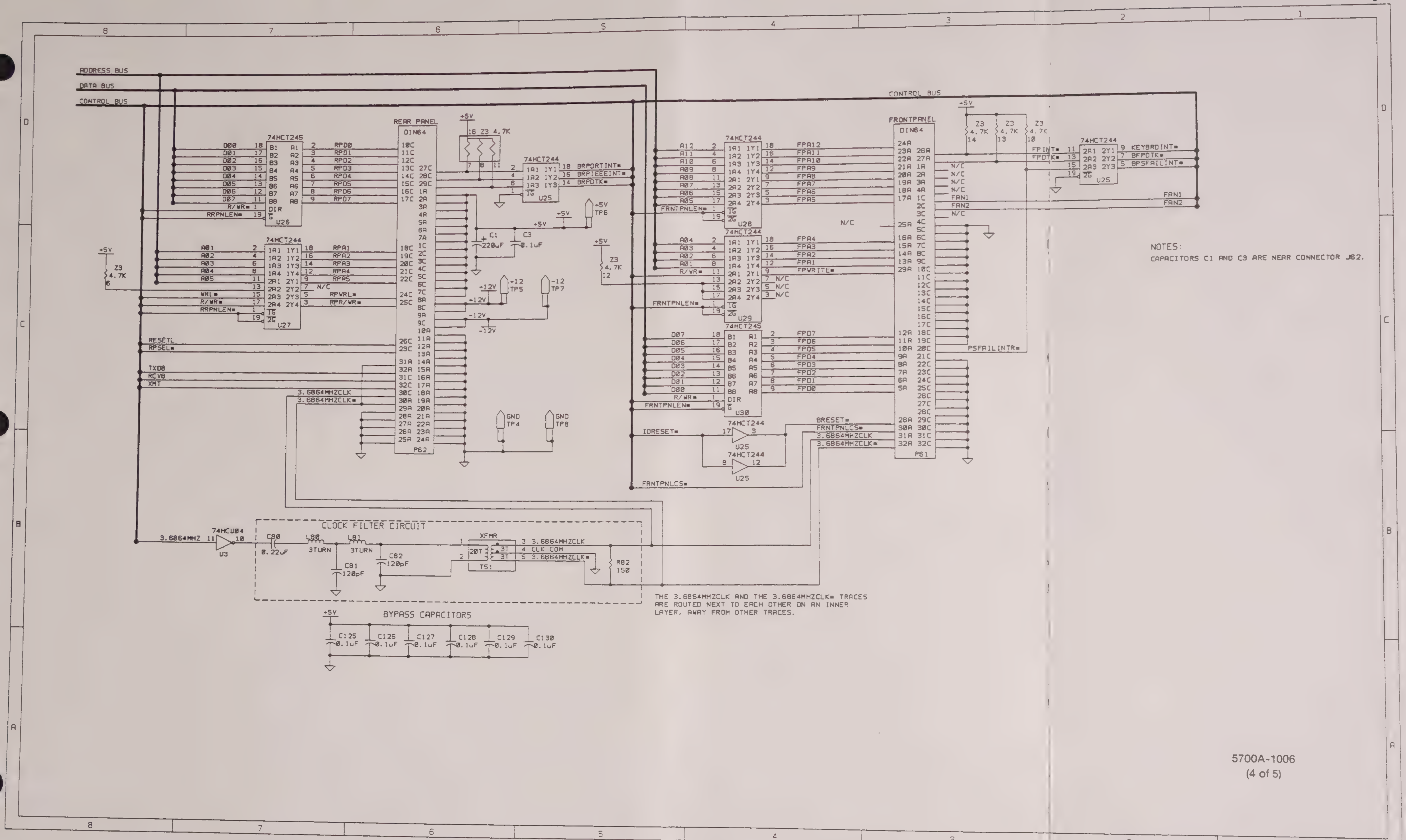


Figure 7-24. A20 CPU PCA (cont)



NOTE:
U23, U24, U40, AND U41 ARE NOT INSTALLED

Figure 7-24. A20 CPU PCA (cont)



NOTES:
CAPACITORS C1 AND C3 ARE NEAR CONNECTOR J62.

THE 3.6864MHZCLK AND THE 3.6864MHZCLK= TRACES ARE ROUTED NEXT TO EACH OTHER ON AN INNER LAYER, AWAY FROM OTHER TRACES.

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Figure 7-24. A20 CPU PCA (cont)

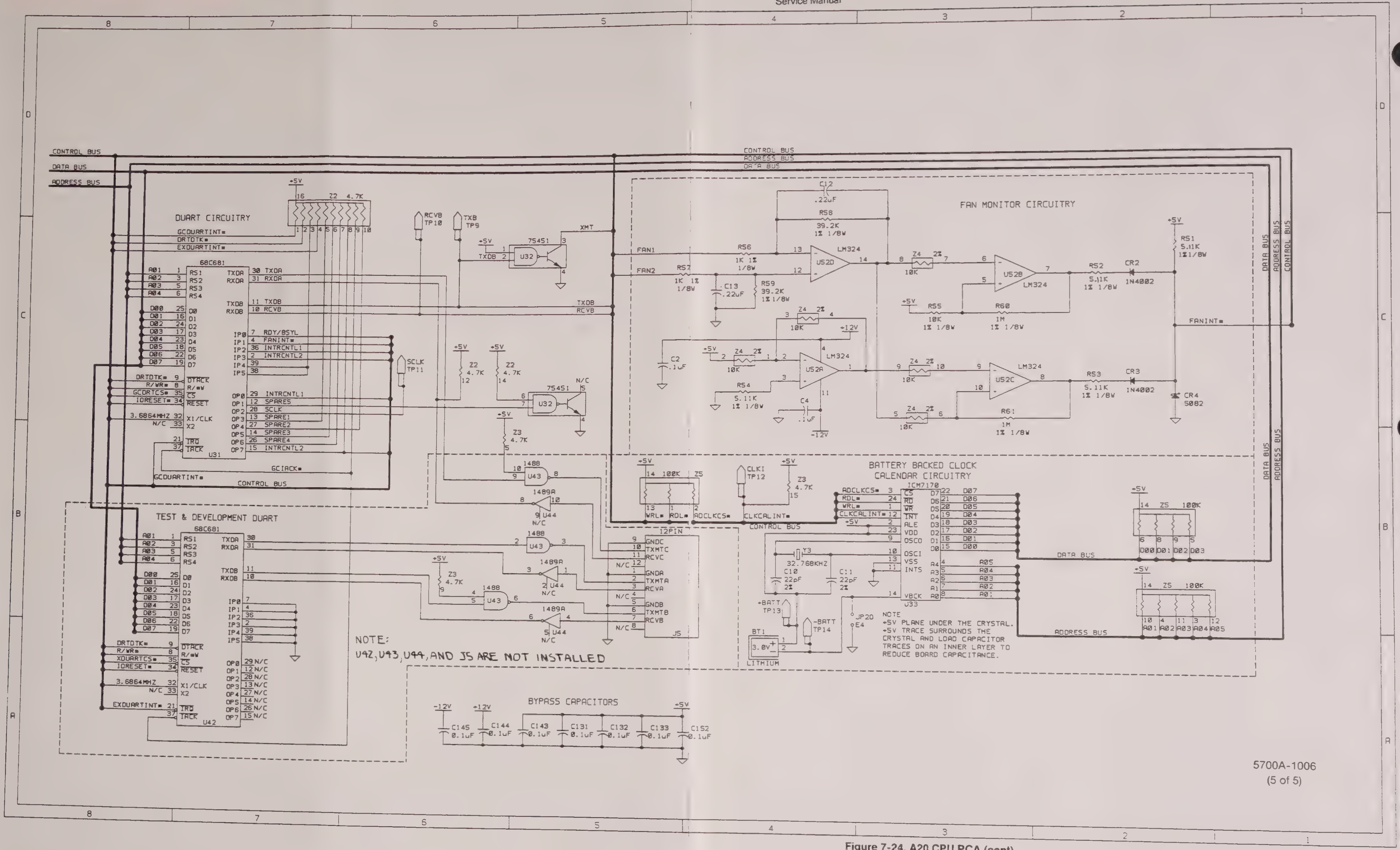


Figure 7-24. A20 CPU PCA (cont)

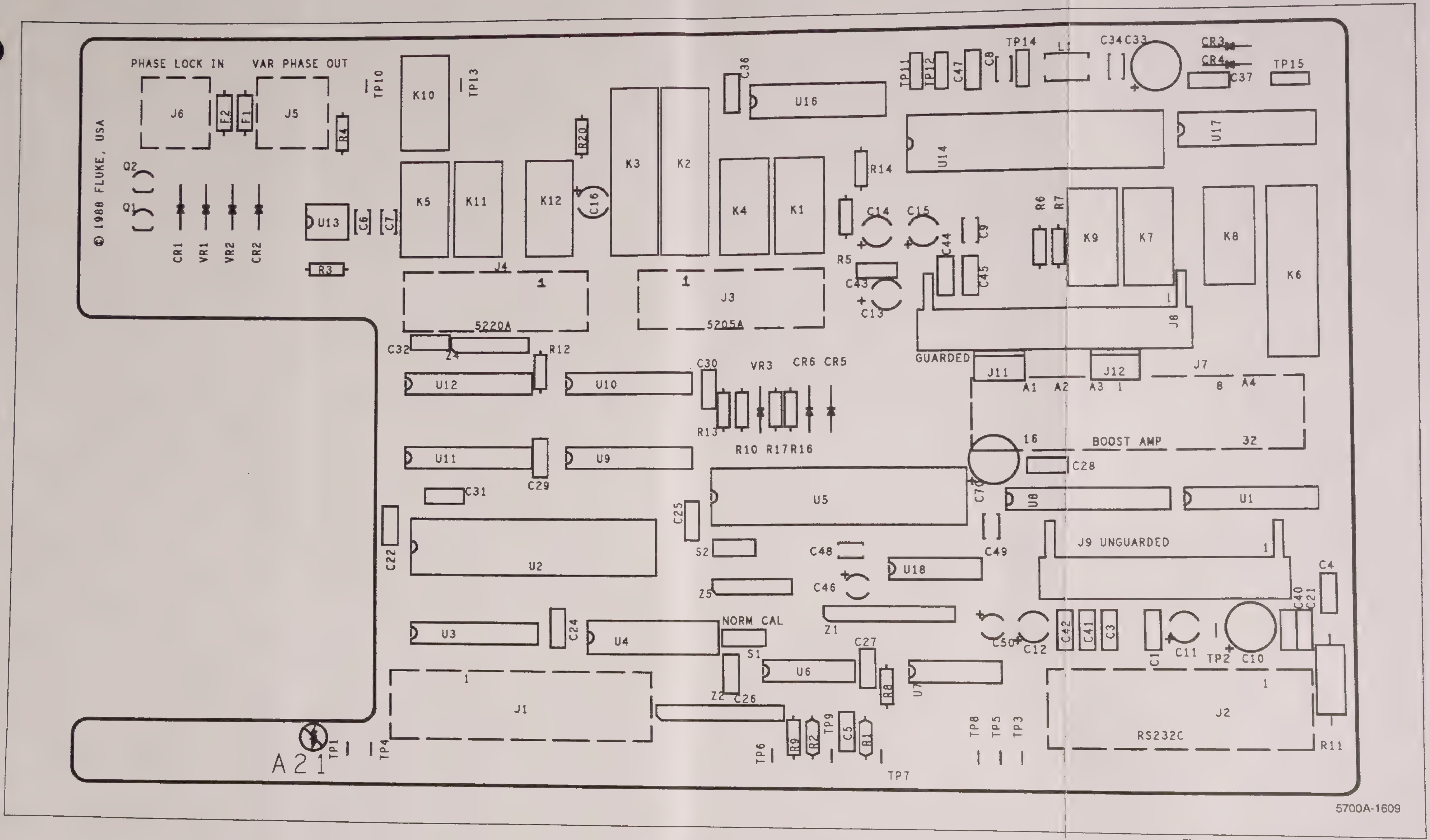
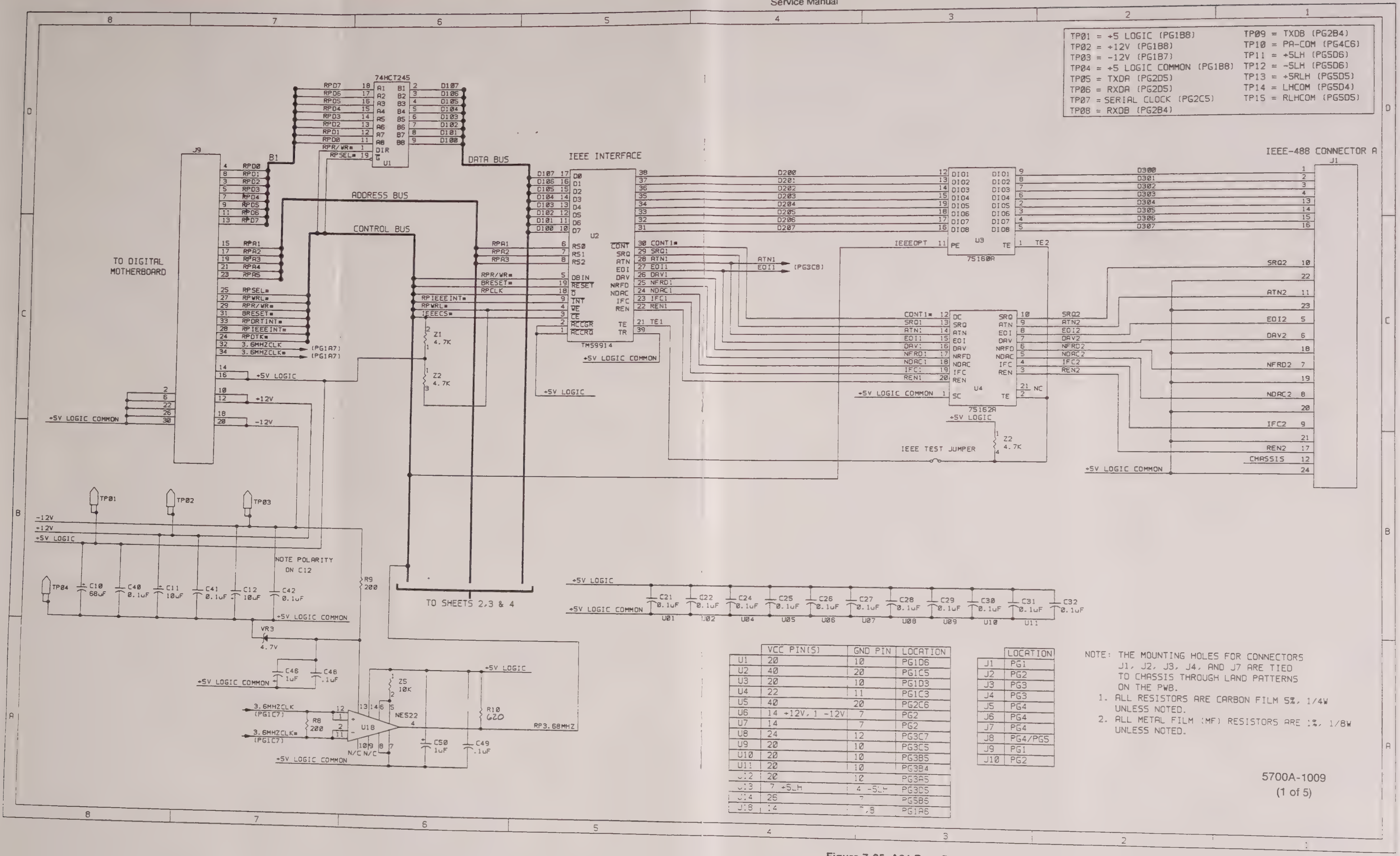


Figure 7-25. A21 Rear Panel PCA



TP01 = +5 LOGIC (PG1B8)
TP02 = +12V (PG1B8)
TP03 = -12V (PG1B7)
TP04 = +5 LOGIC COMMON (PG1B8)
TP05 = TXDA (PG2D5)
TP06 = RXDA (PG2D5)
TP07 = SERIAL CLOCK (PG2C5)
TP08 = RXDB (PG2B4)
TP09 = TXDB (PG2B4)
TP10 = PA-COM (PG4C6)
TP11 = +5LH (PG5D6)
TP12 = -5LH (PG5D6)
TP13 = +5RLH (PG5D5)
TP14 = LHCOM (PG5D4)
TP15 = RLHCOM (PG5D5)

	VCC PIN(S)	GND PIN	LOCATION
U1	20	10	PG1D6
U2	40	20	PG1C5
U3	20	10	PG1D3
U4	22	11	PG1C3
U5	40	20	PG2C6
U6	14 +12V, 1 -12V	7	PG2
U7	14	7	PG2
U8	24	12	PG3C7
U9	20	10	PG3C5
U10	20	10	PG3B5
U11	20	10	PG3B4
U12	20	10	PG3A5
U13	7 +5LH	4 -5LH	PG3D5
U14	26	7	PG5B6
U18	14	7,8	PG1A6

	LOCATION
J1	PG1
J2	PG2
J3	PG3
J4	PG3
J5	PG4
J6	PG4
J7	PG4
J8	PG4/PG5
J9	PG1
J10	PG2

NOTE: THE MOUNTING HOLES FOR CONNECTORS J1, J2, J3, J4, AND J7 ARE TIED TO CHASSIS THROUGH LAND PATTERNS ON THE PWB.

1. ALL RESISTORS ARE CARBON FILM 5%, 1/4W UNLESS NOTED.
2. ALL METAL FILM (MF) RESISTORS ARE 1%, 1/8W UNLESS NOTED.

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Figure 7-25. A21 Rear Panel PCA (cont)

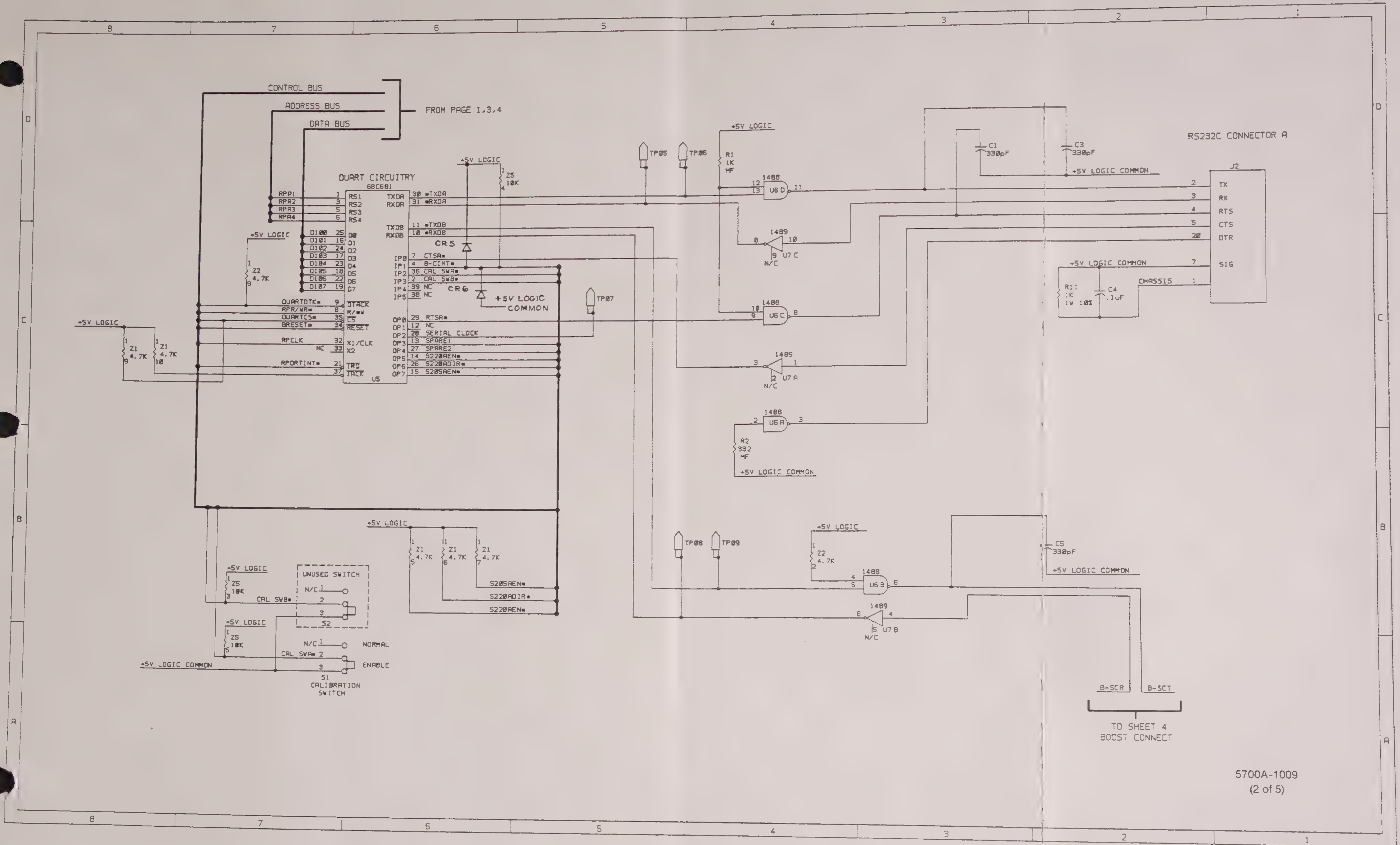


Figure 7-25. A21 Rear Panel PCA (cont)

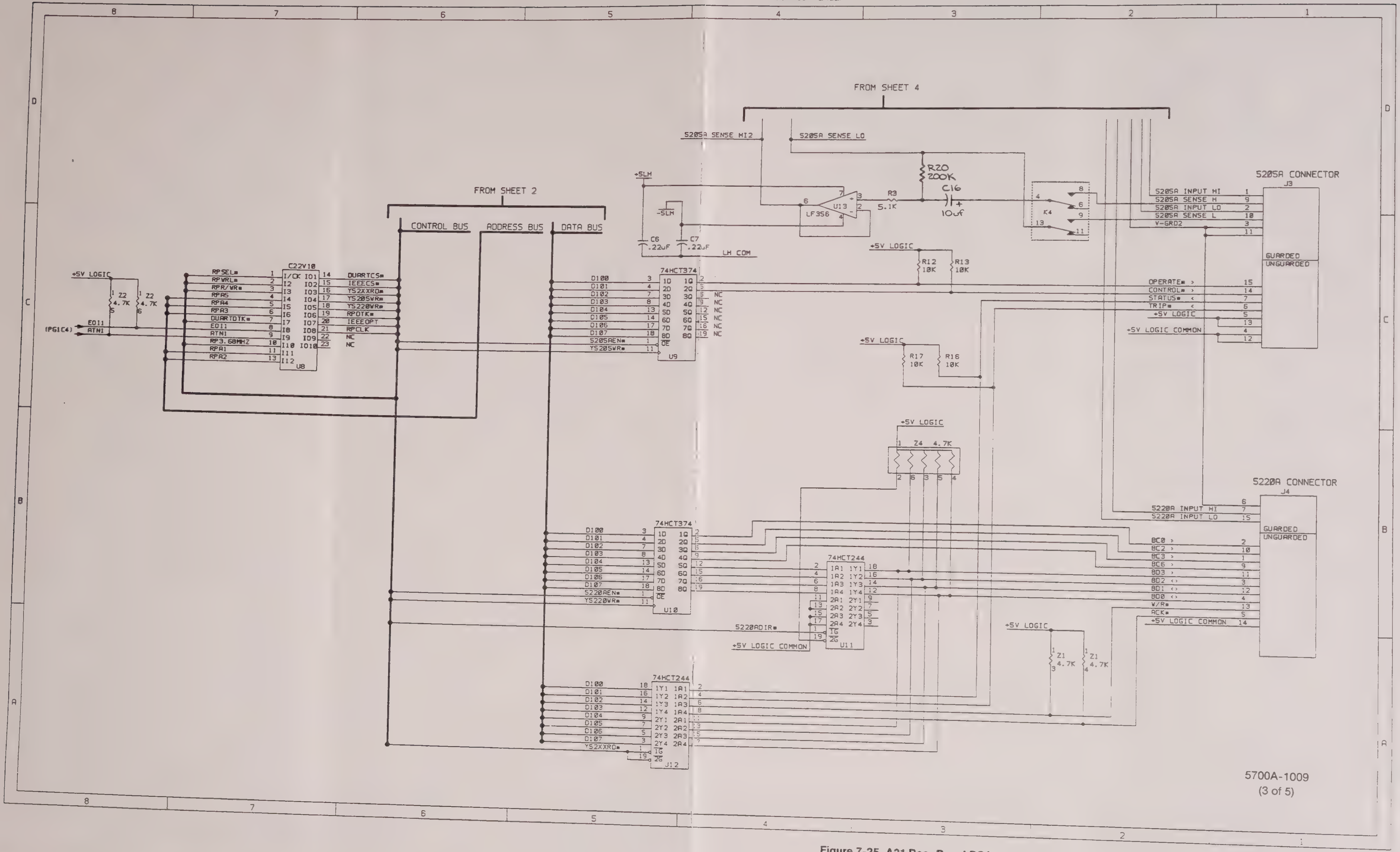


Figure 7-25. A21 Rear Panel PCA (cont)

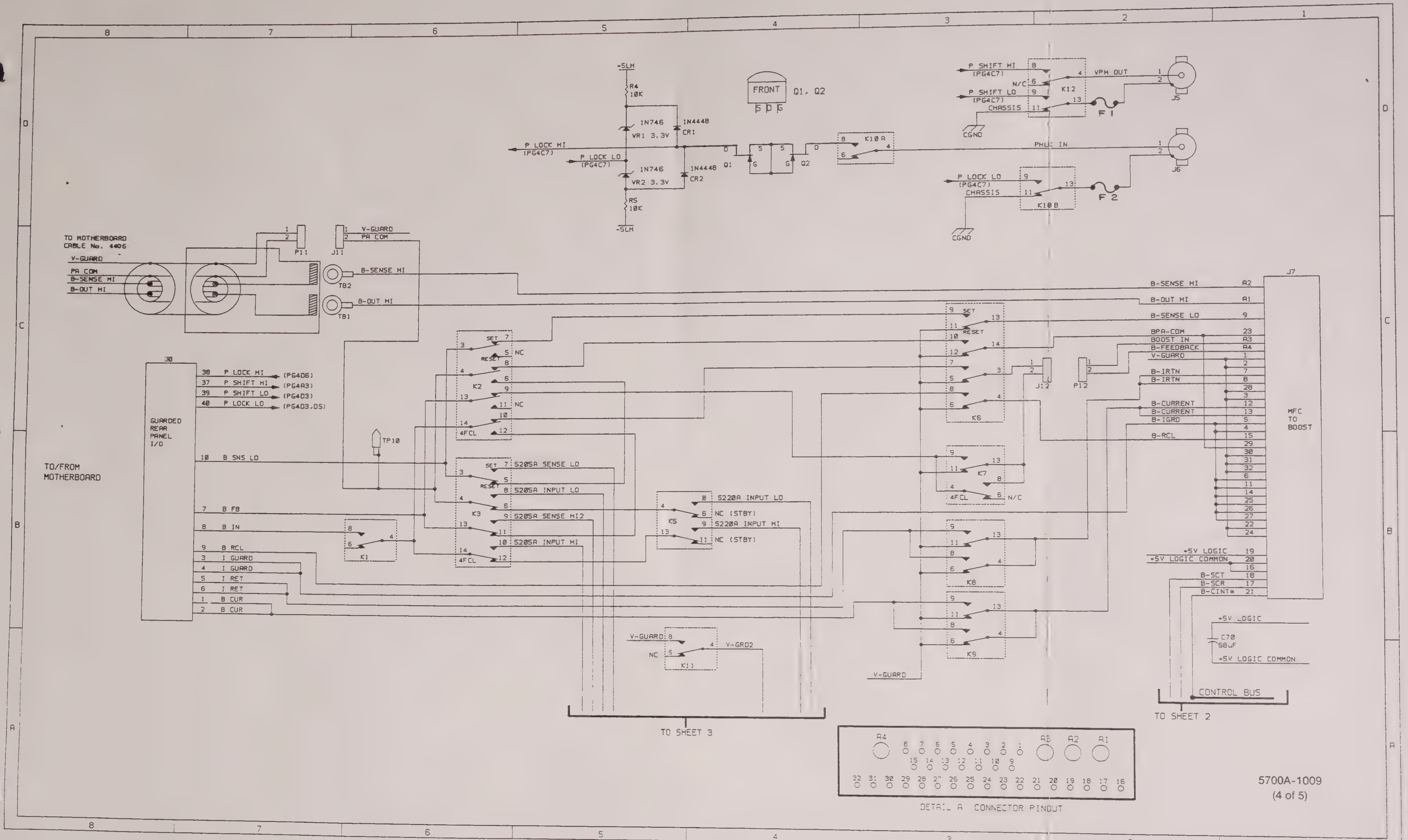
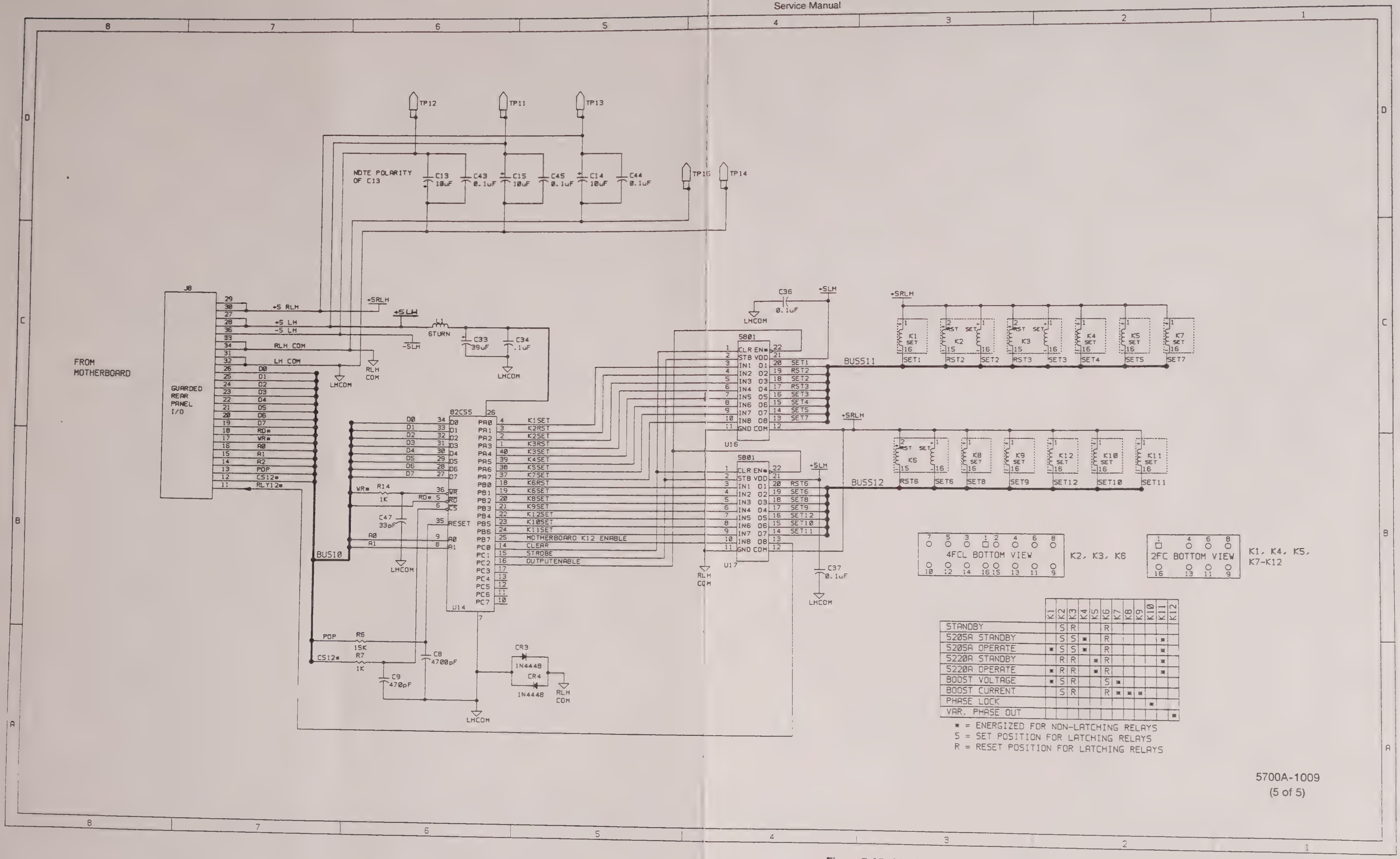


Figure 7-25. A21 Rear Panel PCA (cont)



	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12
STANDBY		S	R			R						
5205A STANDBY		S	S	■		R					■	
5205A OPERATE	■	S	S	■		R					■	
5220A STANDBY		R	R		■	R					■	
5220A OPERATE	■	R	R		■	R					■	
BOOST VOLTAGE	■	S	R			S	■					
BOOST CURRENT		S	R			R	■	■	■			
PHASE LOCK										■		
VAR. PHASE OUT												■

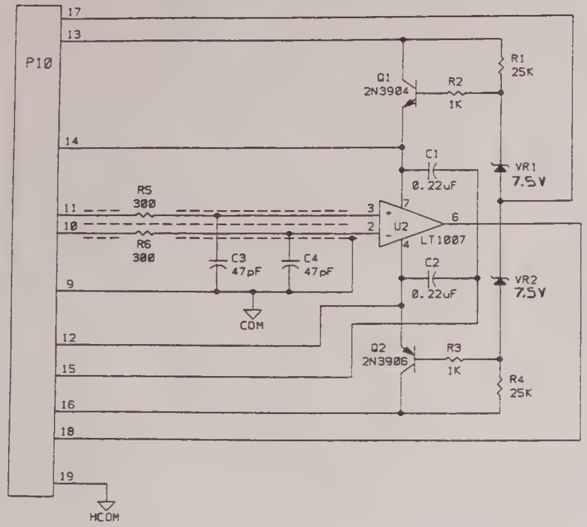
■ = ENERGIZED FOR NON-LATCHING RELAYS
S = SET POSITION FOR LATCHING RELAYS
R = RESET POSITION FOR LATCHING RELAYS

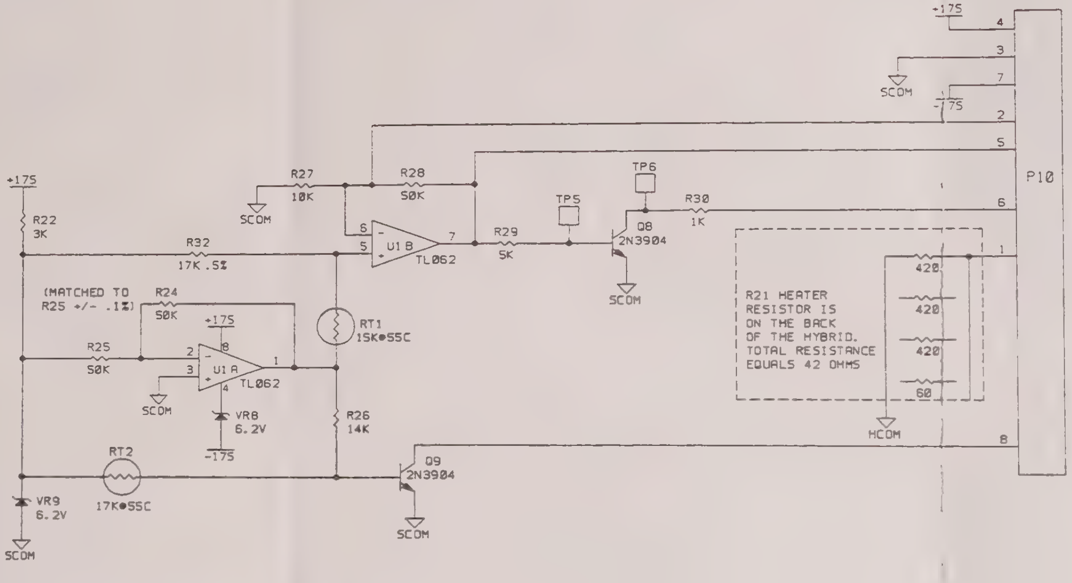
5700A-1009
(5 of 5)

Figure 7-25. A21 Rear Panel PCA (cont)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS, 5%.
2. U2 IS A LT1007C (8 PIN PLASTIC DIP PACKAGE) TO BE MOUNTED FLUSH TO THE SUBSTRATE.
3. SUBSTRATE THICKNESS = 25MIL.
4. USE LA155 LEADS (513622).
5. USE LOW THERMAL MATERIAL ON LEADS (P10 - PINS 10 & 11).

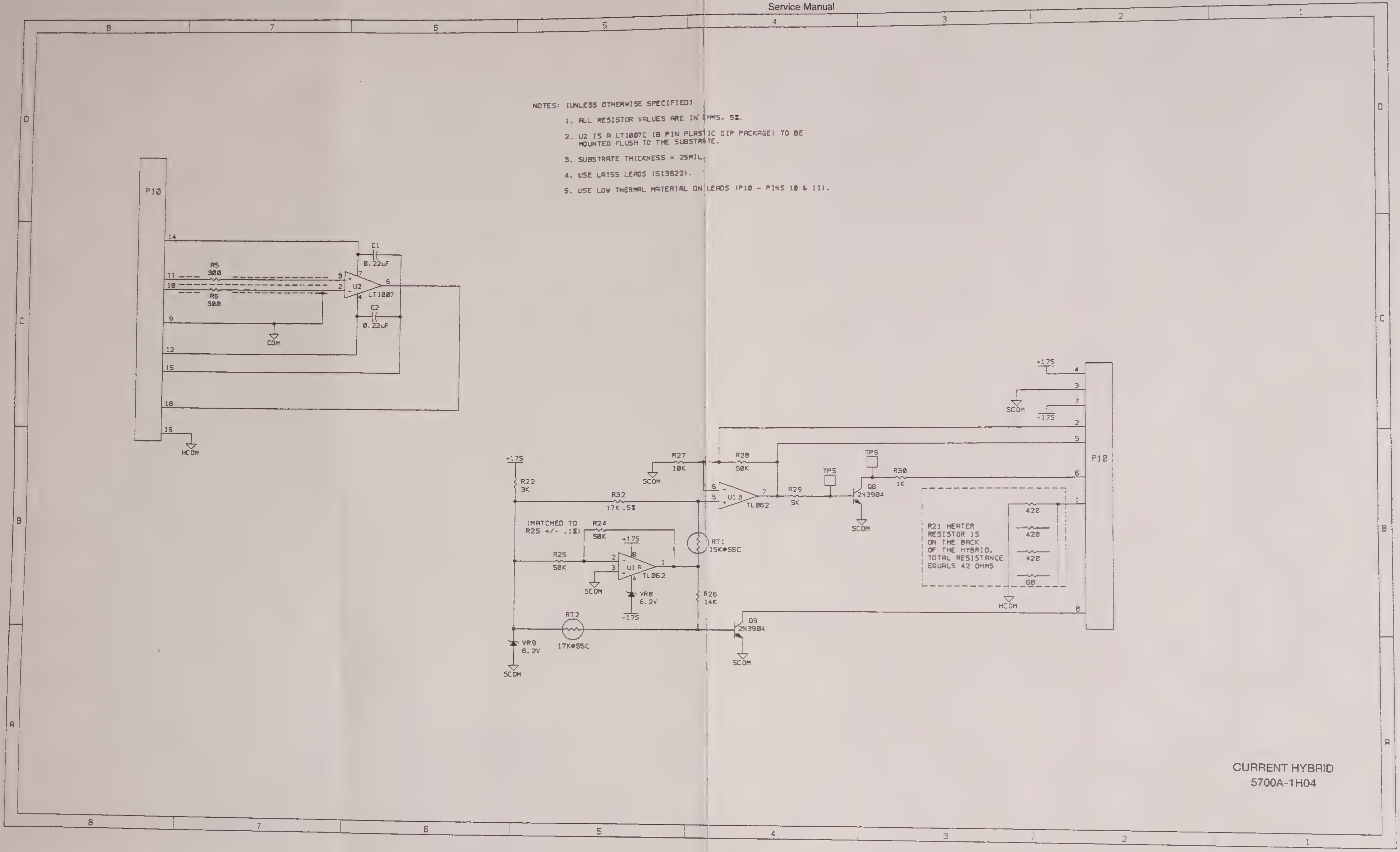




HYBRID NAME	USED ON ASSEMBLY	REF DES	SCHEMATIC
2V DC HYBRID	Switch Matrix (A8)	HR1	1H03
CURRENT HYBRID	Current/Hi-Res Oscillator (A7)	HR2	1H04
REFERENCE HYBRID	DAC (A11)	HR5	1H42
DC AMP HYBRID	DAC (A11)	HR6	1H06
DC AMP HYBRID	High Voltage/High Current (A15)	HR7	1H06
DC AMP HYBRID	Power Amplifier (A16)	HR8	1H06
RES NET HYBRID	Oscillator Output (A13)	U5, U7, U11	1H54

2V DC HYBRID
5700A-1H03

Figure 7-26. Hybrids



NOTES: (UNLESS OTHERWISE SPECIFIED)

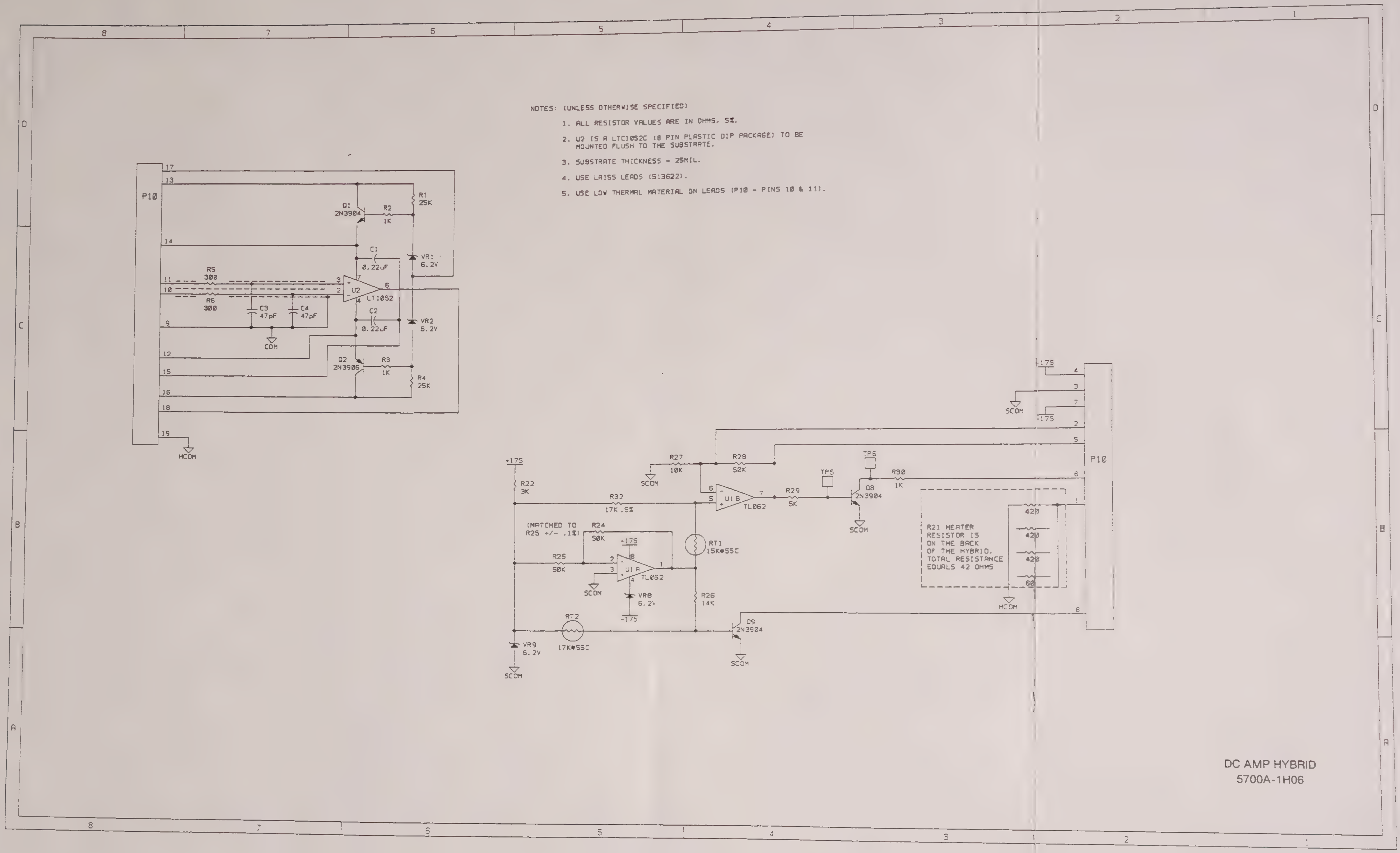
1. ALL RESISTOR VALUES ARE IN OHMS, 5%.
2. U2 IS A LT1007C (8 PIN PLASTIC DIP PACKAGE) TO BE MOUNTED FLUSH TO THE SUBSTRATE.
3. SUBSTRATE THICKNESS = 25MIL.
4. USE LA155 LEADS (513622).
5. USE LOW THERMAL MATERIAL ON LEADS (P10 - PINS 10 & 11).

(MATCHED TO R25 +/- .1%)

R21 HEATER RESISTOR IS ON THE BACK OF THE HYBRID. TOTAL RESISTANCE EQUALS 42 OHMS

CURRENT HYBRID
5700A-1H04

Figure 7-26. Hybrids (cont)



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS, 5%.
2. U2 IS A LTC1052C (8 PIN PLASTIC DIP PACKAGE) TO BE MOUNTED FLUSH TO THE SUBSTRATE.
3. SUBSTRATE THICKNESS = 25MIL.
4. USE LAISS LEADS (513622).
5. USE LOW THERMAL MATERIAL ON LEADS (P10 - PINS 10 & 11).

DC AMP HYBRID
5700A-1H06

Figure 7-26. Hybrids (cont)

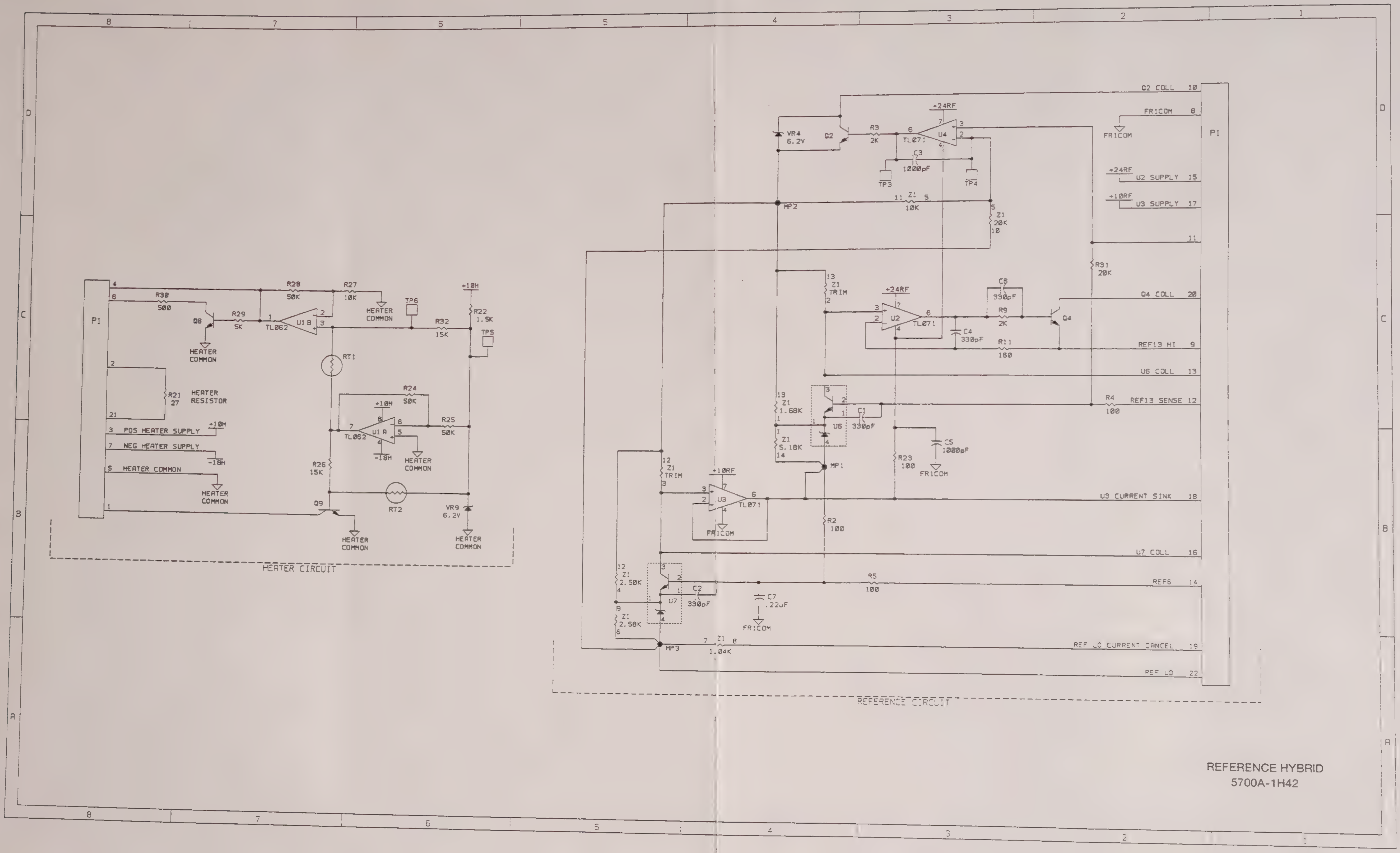
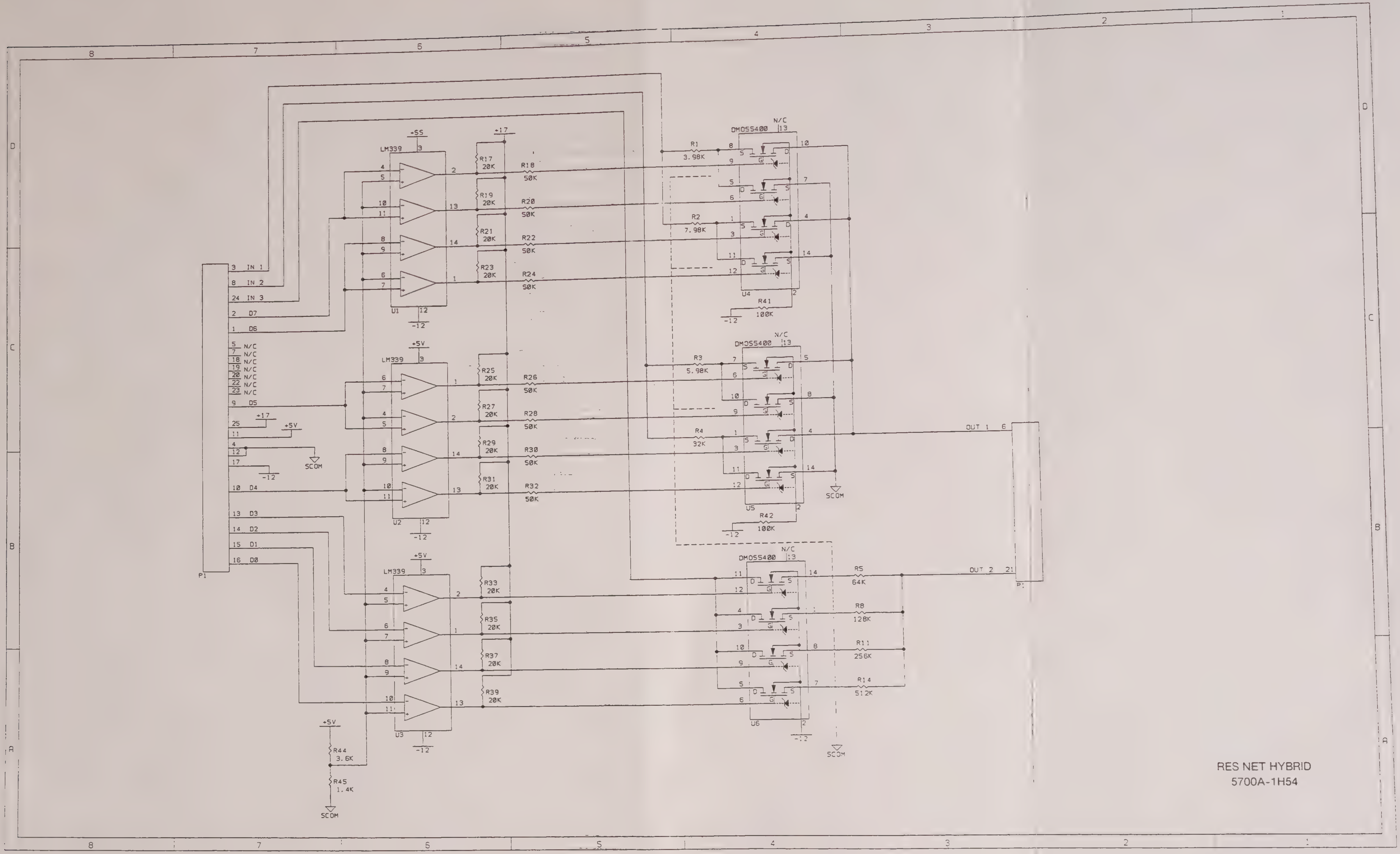


Figure 7-26. Hybrids (cont)



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